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IN THE

# Supreme Court of the United States

OCTOBER TERM, 1993

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CEMENT KILN RECYCLING COALITION,
HOLNAM, INC.,
LONE STAR INDUSTRIES, INC., and
SAFETY-KLEEN CORP.,
*Petitioners,*

v.

CAROL M. BROWNER, ADMINISTRATOR,
U.S. ENVIRONMENTAL PROTECTION AGENCY, and
U.S. ENVIRONMENTAL PROTECTION AGENCY,
*Respondents.*

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**Petition for a Writ of Certiorari to the United States Court of Appeals for the District of Columbia Circuit**

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## APPENDIX TO PETITION FOR WRIT OF CERTIORARI

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**APPENDIX A**

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

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Argued October 25, 1993 Decided February 22, 1994

No. 91-1221

"COMPLEX"
HORSEHEAD RESOURCE DEVELOPMENT COMPANY, INC.,
*Petitioner*

v.

CAROL M. BROWNER, ADMINISTRATOR,
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
AND UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY,
*Respondents*

RSR CORPORATION,
INTERNATIONAL MILL SERVICE,
DOW CHEMICAL COMPANY,
B.F. GOODRICH COMPANY,
AMERICAN IRON AND STEEL INSTITUTE,
AMERICAN MINING CONGRESS,
CHEMICAL WASTE MANAGEMENT, INC.,
ASSOCIATION OF BATTERY RECYCLERS, INC.,
EDISON ELECTRIC INSTITUTE, *et al.*,
SOLITE CORPORATION,
CHEMICAL MANUFACTURERS ASSOCIATION,
AMERICAN PETROLEUM ASSOCIATION,
HAZARDOUS WASTE TREATMENT COUNCIL,
CEMENT KILN RECYCLING COALITION,
BATTERY COUNCIL INTERNATIONAL,
AMERICAN COKE AND COAL CHEMICALS INSTITUTE,

CITIZENS FOR A SAFE ENVIRONMENT, *et al.*,
MARINE SHALE PROCESSORS, INC.,
STEEL MANUFACTURERS ASSOCIATION SPECIALTY
STEEL INDUSTRY OF THE UNITED STATES,
TENNESSEE EASTMAN COMPANY,
CYPRUS MIAMI MINING CORPORATION,
INTERNATIONAL METALS RECLAMATION COMPANY, INC.,
*Intervenors*

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No. 91-1222

ASSOCIATION OF BATTERY RECYCLERS, INC.,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

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No. 91-1223

RSR CORPORATION,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

---

No. 91-1230

SOLITE CORPORATION,
*Petitioner*

v.

CAROL M. BROWNER, ADMINISTRATOR,
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
AND UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY,
*Respondents*

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No. 91-1234

AKJ INDUSTRIES, INC.,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

---

No. 91-1237

MARINE SHALE PROCESSORS, INC.,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

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No. 91-1238

TENNESSEE EASTMAN COMPANY,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

---

No. 91-1240

CITIZENS FOR A SAFE ENVIRONMENT, *et al.*,
*Petitioners*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

AKJ INDUSTRIES, INC.,
*Intervenor*

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No. 91-1241

CHEMICAL MANUFACTURERS ASSOCIATION,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

---

No. 91-1244

AMERICAN IRON AND STEEL INSTITUTE,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

AMERICAN COKE AND COAL CHEMICALS INSTITUTE,
*Intervenor*

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No. 91-1245

CEMENT KILN RECYCLING COALITION,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

---

No. 91-1572

CEMENT KILN RECYCLING COALITION,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

ASSOCIATION OF BATTERY RECYCLERS, INC.,
EDISON ELECTRIC INSTITUTE, *et al.*,
HORSEHEAD RESOURCE DEVELOPMENT COMPANY, INC.,
DOW CHEMICAL COMPANY,
INTERNATIONAL MILL SERVICE, INC.,
AMERICAN MINING CONGRESS,
AMERICAN IRON AND STEEL INSTITUTE,
*Intervenors*

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No. 91-1575

SOLITE CORPORATION,
*Petitioner*

v.

CAROL M. BROWNER, ADMINISTRATOR,
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
AND UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY,
*Respondents*

ASSOCIATION OF BATTERY RECYCLERS, INC.,
EDISON ELECTRIC INSTITUTE, *et al.*,
AMERICAN MINING CONGRESS,
DOW CHEMICAL COMPANY,
INTERNATIONAL MILL SERVICE, INC.,
HORSEHEAD RESOURCE DEVELOPMENT COMPANY, INC.,
AMERICAN IRON AND STEEL INSTITUTE,
*Intervenors*

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No. 91-1576

TENNESSEE EASTMAN COMPANY,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

ASSOCIATION OF BATTERY RECYCLERS, INC.,
HORSEHEAD RESOURCE DEVELOPMENT COMPANY, INC.,
DOW CHEMICAL COMPANY,
INTERNATIONAL MILL SERVICE, INC.,
AMERICAN MINING CONGRESS,
AMERICAN IRON AND STEEL INSTITUTE,
EDISON ELECTRIC INSTITUTE, *et al.*,
*Intervenors*

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No. 92-1392

CONTINENTAL CEMENT COMPANY,
LONE STAR INDUSTRIES, INC.,
HOLNAM INC.,
SAFETY-KLEEN CORPORATION,
*Petitioners*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

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No. 92-1459

CEMENT KILN RECYCLING COALITION,
*Petitioner*

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

EDISON ELECTRIC INSTITUTE,
NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION,
AMERICAN PUBLIC POWER ASSOCIATION,
UTILITY SOLID WASTE ACTIVITIES GROUP,
AMERICAN MINING CONGRESS,
*Intervenors*

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No. 92-1601

LAFARGE CORPORATION,

v. *Petitioner*

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

EDISON ELECTRIC INSTITUTE,
NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION,
AMERICAN PUBLIC POWER ASSOCIATION,
UTILITY SOLID WASTE ACTIVITIES GROUP,
*Intervenors*

---

No. 92-1610

GIANT GROUP, LTD.,

v. *Petitioner*

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,
*Respondent*

EDISON ELECTRIC INSTITUTE,
NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION,
AMERICAN PUBLIC POWER ASSOCIATION,
UTILITY SOLID WASTE ACTIVITIES GROUP,
*Intervenors*

---

Petitions for Review of an Order of the
Environmental Protection Agency

---

Before: WALD, EDWARDS and BUCKLEY, *Circuit Judges.*

Opinion for the Court filed *Per Curiam.*

*Per Curiam*: This case involves challenges by industy and environmentalist petitioners to an Environmental Protection Agency ("EPA") rule interpreting section

3004(q) of the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. § 6924(q) (1988), which directs the agency to regulate facilities burning hazardous waste as fuel. The rule, entitled "Burning of Hazardous Waste in Boilers and Industrial Furnaces" ("BIF Rule"), 56 Fed. Reg. 7,134 (1991) (codified as amended by subsequent corrections and technical amendments at 40 C.F.R. Parts 260, 261, 264, 265, 266, 270, 271 (1992)), is principally designed to establish air emissions requirements for facilities burning hazardous waste as fuel. The BIF Rule also integrates the mandates of section 3004(q) and the Bevill Amendment, the latter of which is a RCRA provision that excludes certain types of waste from RCRA Subtitle C's hazardous waste management regime until the EPA completes several studies and submits their results to Congress. *See* 42 U.S.C. § 6921(b)(3)(a) (1988).

Petitioners attack the BIF Rule on three grounds.[1] First, both groups of petitioners contend that the BIF Rule fails to adhere to what they regard as Congress' clear expression of its intent in the Bevill Amendment. There are two types of "Beville wastes" at issue in this case: cement kiln dust ("ckd"); and combustion residues produced when BIF's burn fuel consisting primarily of coal, oil, and other fossil fuels. Although the Bevill Amendment states that ckd and fossil fuel combustion residues are exempt from Subtitle C pending completion of the required studies, the BIF Rule provides that these Bevill wastes can under some circumstances be regulated as Subtitle C hazardous wastes *when they are produced by BIF's burning fuel which contains hazardous waste.* Industry Petitioners contend that the Bevill Amendment exempts ckd and fossil fuel combustion residues from Subtitle C regardless of whether they are the product of hazardous waste fuels. Environmentalist petitioners, Citizens for a Safe Environ-

[1] The two groups of petitioners originally offered twelve separate challenges to the BIF Rule; however, all but three of these issues were resolved by settlements between the parties on the eve of oral argument. We address only the three remaining challenges.

ment, *et al.* ("CASE petitioners"), make the opposite argument, contending that Bevill wastes produced by BIF's burning any quantum of hazardous waste are automatically subject to Subtitle C. We reject both of these challenges and uphold the BIF Rule as a permissible interpretation of RCRA § 3004(q) and the Bevill Amendment.

Second, we uphold the BIF Rule insofar as it regulates air emissions from BIF's burning mixtures of hazardous waste and non-waste fuel. Industry petitioners contend that the rule is invalid because non-waste fuels are outside the EPA's jurisdiction under RCRA. We hold, however, that RCRA § 3004(q) gives the EPA the authority to regulate *facilities* which burn hazardous waste, not merely the hazardous waste component of the fuel they burn. The EPA contends that it is not technologically feasible to distinguish air emissions generated solely by the hazardous waste component of mixed fuels. Because BIF's that burn hazardous waste are "treating" that waste as that term is defined in RCRA, we can find no error in the EPA's position that air emissions from the co-processing mixed hazardous waste and non-waste fuels have a sufficiently close nexus to waste treatment to justify the regulation at issue. In addition, we hold that the agency's failure explicitly to respond to the specific alternatives proposed by Industry petitioners was not arbitrary and capricious because the EPA's general discussion of its decision to regulate non-waste fuels provided a sufficient response to Industry petitioners' proposals.

Finally, Industry petitioners challenge the EPA's purported regulation of products of incomplete combustion ("PICs") produced when BIFs burn hazardous waste fuel. We remand "Tier III" of the PIC provisions of the BIF Rule on the grounds that the regulation was promulgated without adequate notice and comment, and because the disputed rule lacks an adequate basis in the rulemaking record; however, we uphold the Tier I and Tier II standards.

## 1. BACKGROUND

Subtitle C of RCRA establishes a comprehensive "cradle-to-grave" regulatory program for the treatment, storage, and disposal of hazardous waste. *United Technologies Corp. v. EPA*, 821 F.2d 714, 716 (D.C. Cir. 1987). For RCRA purposes, burning hazardous waste constitutes "treatment" of it,[2] thus giving the EPA the authority to regulate this activity. The EPA promulgated the BIF Rule pursuant to the mandate of RCRA section 3004(q), which directs the agency to establish standards which will "protect human health and the environment" governing facilities that burn fuel containing hazardous waste. 42 U.S.C. § 6924(q) (1988).[3]

Hazardous waste is burned for three purposes: to destroy the waste (incineration), to serve as fuel (energy

---

[2] *See* 42 U.S.C. § 6903(34) (1988) ("treatment" means "any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste. . . ."); 40 C.F.R. § 260.10 (1922) ("treatment" includes "any method, technique, or process . . . designed to . . . recover energy or material resources from [hazardous] waste. . . ."); *see also Shell Oil Co. v. EPA*, 950 F.2d 741, 752-56 (D.C. Cir. 1991) (upholding the EPA's decision to incorporate resource recovery within the regulatory definition of "treatment").

[3] The relevant portion of RCRA § 3004(q) reads:

> (q) Hazardous waste used as fuel
>
> (1) Not later than two years after November 8, 1984, and after notice and opportunity for public hearing, the Administrator shall promulgate regulations establishing such—
>
> (A) * * *
>
> (B) standards applicable to the owners of facilities which burn, for purposes of energy recovery, any fuel [produced from or mixed with hazardous waste or] which otherwise contains any hazardous waste identified or listed under section 6921 of this title. . . .
>
> * * * *

as may be necessary to protect human health and the environment. 42 U.S.C. § 6924(q) (1988).

recovery), and to recover usable materials such as metals (materials recovery). Hazardous waste often has a great deal of heat value when used as a fuel; and this use also has the benefit of destroying or at least reducing the volume of the waste, thereby reducing reliance on landfilling. In its early attempts to implement Subtitle C, the EPA was particularly concerned that its regulations not discourage beneficial uses of hazardous wastes, such as energy recovery and recycling. *See* 45 Fed. Reg. 33,804 at 33,092-94 & 33,120 (1980). For this reason, in 1981, the EPA deferred regulating air emissions from BIF's burning hazardous waste as fuel or for materials recovery, but did adopt rules controlling emissions from hazardous waste incinerators, which burn waste primarily in order to destroy it. 46 Fed. Reg. 7,666, 7,678 (1981).

Exempting facilities that burned hazardous waste for energy recovery from Subtitle C's requirements created a regulatory "loophole" by means of which over half of the hazardous waste generated in the United States came to be burned in BIF's not subject to RCRA. H.R. Rep. No. 198, 98th Cong., 1st Sess., pt. 1, at 39 (1983). Congress closed this loophole by enacting RCRA section 3004(q) as part of the Hazardous and Solid Waste Amendments of 1984, Pub. L. No. 98-616, § 204, 98 Stat. 3221. Section 3004(q) set a deadline of November 8, 1986 for the EPA to promulgate regulations governing the burning of hazardous waste for energy recovery.

In 1985, in response to section 3004(q), the EPA imposed its first controls on the marketing and burning of hazardous waste fuels. 50 Fed. Reg. 665 (1985); 50 Fed. Reg. 49,164 (1985). These regulations provide that hazardous waste or fuels containing hazardous waste are subject to transportation and storage controls under Subtitle C prior to being burned as fuel or being blended or processed for use as fuel.

In 1987, again pursuant to section 3004(q), the EPA published its proposed BIF Rule for public comment. 52

Fed. Reg. 16,982-17,050 (1987). The EPA issued a supplemental rulemaking proposal in 1989. 54 Fed. Reg. 43,718-63 (1989). The final BIF Rule, which we review in the instant case, was published in the Federal Register in 1991. 56 Fed. Reg. 7,134-240 (1991). The EPA subsequently promulgated a series of technical amendments and clarifications to the BIF Rule. *See* Corrections and Technical Amendments, 56 Fed. Reg. 32,688-852 (1991); Technical Amendments, 56 Fed. Reg. 42,504-17 (1991); Technical Clarification Amendments and Corrections, 57 Fed. Reg. 38 558-66 (1992).

## II. Discussion

### A. *Standard of Review*

The standard of review in this case is the familiar two-part framework of *Chevron U.S.A., Inc. v. Natural Resources Defense Council*, 467 U.S. 837 (1984). First, the court asks whether Congress "has directly spoken to the precise question at issue." *Id.* at 842. If so, then the intent of Congress is controlling. If, however, the meaning of the statute is ambiguous, then we will uphold the agency's interpretation so long as it is "based on a permissible construction of the statute." *Id.*

As this court explained in *Natural Resources Defense Council v. Reilly*, 983 F.2d 259, 266 (D.C. Cir. 1993):

> [I]t is only legislative intent to delegate such authority that entitles an agency to advance its own statutory construction for review under the deferential second prong of *Chevron*. *See Chevron*, 467 U.S. at 843-44. "If Congress has explicitly left a gap for the agency to fill, there is an express delegation of authority. . . . Sometimes the legislative delegation to an agency on a particular question is implicit rather than explicit. In such a case, a court may not substitute its own construction of a statutory provision for a reasonable interpretation made by the administrator of an agency." *Id.*

CASE petitioners and Industry petitioners attack the BIF Rule's interpretation of the Bevill Amendment from opposite directions, both relying on *Chevron* step one to argue that Congress' clearly expressed intent requires the outcome they advocate. CASE petitioners argue that the EPA may not exempt any co-processed Bevill wastes from Subtitle C because Congress did not intend for the Bevill Amendment to cover combustion residues or ckd produced by fuel that contains hazardous waste. Industry petitioners argue that when Congress enacted the Bevill Amendment it was aware that Bevill devices and BIF's burned hazardous waste, and that the amendment was intended to exempt ckd and residues without regard to the type of fuel that produced them. The EPA contends, and we agree, that the language of the Bevill Amendment does not unambiguously address the issue of hazardous waste fuels burned in Bevill devices, and that its regulation is a permissible interpretation of the statute under *Chevron* step two.

B. *Interpretation of the Bevill Amendment Under the BIF Rule*

1. *The Bevill Amendment*

The Bevill Amendment [4] to RCRA limits the authority of the EPA to regulate certain enumerated types of solid

---

[4] 42 U.S.C. § 6921(b)(3)(a) (1988):

> [E]ach waste listed below shall, except as provided in subparagraph (B) of this paragraph, be subject only to regulation under other applicable provisions of Federal or State law in lieu of this subchapter until at least six months after the date of submission of the applicable study required to be conducted under subsection (f), (n), (o), or (p) of section 6982 of this title and after promulgation of regulations in accordance with subparagraph (C) of this paragraph:
>
> > (i) Fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels.

[Continued]

wastes until it completes studies concerning them and submits the results of those studies to Congress. The EPA has yet to complete the relevant studies, although the statutory deadlines expired in 1982 and 1983. *See* 42 U.S.C. § 6982(*n*), (*o*) (1988). Two classes of Bevill wastes are relevant to the dispute before us: cement kiln dust or "ckd," which is the particulate matter emitted in the exhaust gases of cement kilns that is collected by emission control devices such as fabric filters or electrostatic precipitators; and combustion residues, such as ash and particulates, which are generated primarily from the combustion of coal or other fossil fuels.

This court has described the origins of the Bevill Amendment at length in three previous decisions concerning the provision for mining wastes, 42 U.S.C. § 6924 (b)(3)(a)(ii) (1988). *See Solite Corp. v. EPA*, 952 F.2d 473, 477-82 (D.C. Cir. 1991); *Environmental Defense Fund v. EPA*, 852 F.2d 1316, 1318-21 (D.C. Cir. 1988), *cert. denied*, 489 U.S. 1011 (1989) (*"EDF II"*); *Environmental Defense Fund v. EPA*, 852 F.2d 1309, 1310-12 (D.C. Cir. 1988), *cert. denied*, 489 U.S. 1011 (1989) (*"EDF I"*). Here we need only summarize our earlier holdings as to Congress' intent in enacting the Amendment.

In 1978, in its first proposal for regulation of hazardous waste under Subtitle C, the EPA proposed to create a category of "special wastes," among which were ckd and combustion residues produced by utilities, for which special, less stringent standards might be appropriate. *See* 43 Fed. Reg. 58,946, 58,992 (1978). The EPA had not yet fully studied these special wastes, but the agency believed they potentially presented unique problems because

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[4] [Continued]

(ii) Solid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore.

(iii) Cement kiln dust waste.

they were generated in very large volumes but posed relatively low hazards to human health. Because of the large volumes of these wastes, the EPA was concerned that it might be impractical to dispose of them in facilities that fully complied with Subtitle C of RCRA. However, the EPA eventually decided to abandon the concept of "special wastes." The agency pointed out that the definition of hazardous waste in its final regulations was less stringent than the one it had initially proposed (meaning fewer special wastes would qualify as hazardous wastes), and that the final waste management standards were more flexible than those it had originally proposed. Thus, it was felt that there was no need for a category of "special wastes." *See* 45 Fed. Reg. 33,084, 33,174-75 (1980); *EDF II*, 852 F.2d at 1319; *EDF I*, 852 F.2d at 1311.

One month before the 1980 Subtitle C regulations were to take effect, Congress enacted the Bevill Amendment as part of the Solid Waste Disposal Act Amendments of 1980, Pub. L. No. 96-482, 94 Stat. 2334, 2337 § 7. In response, the EPA amended its hazardous waste regulations in November 1980 to incorporate the Bevill Amendment's exemption of ckd, mining wastes and fossil fuel combustion residues from the requirements of Subtitle C. 45 Fed. Reg. 76,618 (1980).

In *EDF II*, this court held that "it is clear that Congress intended the Bevill exclusion to encapsulate the 'special waste' concept articulated by the EPA in 1978." *EDF II*, 852 F.2d at 1329. That case held that the EPA was not permitted simply to exempt from Subtitle C all mining wastes potentially within the scope of the Bevill Amendment, but rather was required to comply with Congress' clearly expressed intent that the agency exempt only those mining wastes that would have fallen within the category of "special wastes." *EDF II* thus required the EPA to develop criteria to determine whether potentially exempt mining wastes were "high volume, low hazard" wastes, such as the EPA had proposed to include in the "special waste" category in 1978. *Id.* at 1331. Accordingly, this

court also held that the EPA could not continue to grant a Bevill exemption from Subtitle C to six types of smelter wastes that the agency had found to be low volume and high hazard, because such wastes were outside the scope of the Bevill Amendment. *Id.* at 1329-30.

In *Solite* we reviewed the EPA's regulatory definitions of the Bevill Amendment's high volume/low hazard criteria for mining wastes, which the agency had promulgated in response to our decision in *EDF II*. *Solite* reaffirmed *EDF II*'s holding that Congress intended the Bevill Amendment to encapsulate the special waste concept. *See Solite*, 952 F.2d at 482-83 (quoting *EDF II*, 852 F.2d at 1329). This court went on to hold, however, that Congress had not directly addressed "the appropriate *delineation* of the 'special waste' concept, and the attendant 'high volume' and 'low hazard' criteria. . . ." *Id.* at 482 (emphasis added). Our review of the EPA's volume and hazard criteria for mining waste thus was limited to the question of whether the agency's interpretation was a permissible construction of the Bevill Amendment. *Id.* (citing *Chevron*, 467 U.S. at 843).

2. *The Integration of the Bevill Amendment and Section 3004(q) Mandates Under the BIF Rule*

The EPA has adopted a two-part definition of "hazardous wastes" that are subject to Subtitle C. "Characteristic hazardous wastes" are substances exhibiting one or more of four hazardous characteristics: ignitability, corrosivity, reactivity and toxicity. *See* 40 C.F.R. Part 261, Subpart C (1992). "Listed hazardous wastes" are those substances the EPA has enumerated in published lists of specified wastes. *See id.* at Subpart D. By regulation, a listed waste continues to be regulated as a hazardous waste after it is mixed with other wastes—a provision known as the "mixture rule." 40 C.F.R. § 261.3(a)(2)(iv) (1992). A listed waste also remains a hazardous waste for Subtitle C purposes even after it is "treated" in some fashion—the so-called "derived-from" rule. 40 C.F.R. § 261.3(c)(2)

(1), (d)(2) (1992). As noted above, for RCRA purposes, the burning of a hazardous waste for any purpose, whether for fuel, materials recovery or destruction, constitutes "treatment." 42 U.S.C. § 6903(34) (1988).[5]

All parties to this litigation agree that ckd and combustion residues from Bevill devices burning hazardous waste fuel would be subject to Subtitle C by operation of the derived-from rule absent the Bevill Amendment; this is so because they would contain residues from the burning of hazardous waste. The question before this court is the extent to which the Bevill Amendment does or does not exempt ckd and combustion residues produced by burning fossil fuels mixed with hazardous waste from the operation of the derived-from rule.

The BIF Rule integrates the mandates of the Bevill Amendment and section 3004(q) by providing both quantitative and qualitative requirements which Bevill wastes must satisfy in order to retain their exemption from Subtitle C. 40 C.F.R. § 266.112 (1992). The quantitative aspect of the rule requires that in order for ckd to retain its Bevill exemption, the kiln producing it must process at least fifty percent by weight of ordinary, non-hazardous waste raw materials. *Id.* § 266.112(a)(3). The EPA noted in its statement accompanying the final BIF Rule that although the Bevill Amendment refers to devices burning "primarily" fossil fuels, it does not explicitly so limit the Subtitle C exclusion for ckd. The agency determined, however, that, to retain its Bevill exclusion, a cement kiln must burn chiefly non-hazardous waste mate-

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[5] In 1991, in *Shell Oil Co. v. EPA*, 950 F.2d 741 (D.C. Cir. 1991), this court vacated the mixture and derived-from rules for failure to give adequate opportunity for notice and comment. The *Shell Oil* decision suggested, however, that the EPA repromulgate the rules on an interim basis under the APA's good cause exemption, *id.* at 752, and the agency did so on March 3, 1992. 57 Fed. Reg. 7,628 (1992). The interim rule has been challenged in *Mobil Oil Corp. v. EPA*, No. 92-1211, currently scheduled for oral argument before this court on March 8, 1994.

rials. *See* 56 Fed. Reg. 7,134, 7,197-98 (1991). This provision apparently is intended to prevent cement kilns from effectively becoming hazardous waste incinerators by burning far more waste than actually necessary to fuel cement making. The EPA interpreted the Bevill Amendment's exclusion for residues "primarily from the combustion of coal or other fossil fuels" as exempting only residues from BIF's burning at least fifty percent coal.[6] Residues from BIFs burning oil or gas mixed with any quantity of hazardous waste are not covered by the Bevill Amendment because oil and gas generally produce very little combustion residue, so any residue from the co-processing of these fuels with hazardous waste would necessarily be "significantly affected" by the hazardous waste. *Id.* at 7,198 n.87.

The BIF Rule's qualitative requirements provide that Bevill wastes which meet the foregoing quantative criteria remain exempt from Subtitle C so long as they have not been "significantly affected" by the burning of hazardous waste. The EPA has established a test to be performed on a case-by-case basis at each facility to determine whether co-processed Bevill wastes have been "significantly affected." *See* 56 Fed. Reg. 7,196-99 (1991). The agency considered adopting uniform baseline levels rather than requiring site-specific testing, but determined that it did not have sufficient data to do so. *See id.* at 7,198; 54 Fed. Reg. 43,718 at 43,734 & 43,735-36 (1989).

The "significantly affected" test consists of two parts. First, a Bevill device operator may opt to determine whether concentration of specified toxic compounds in co-processed residue are significantly higher than in residues produced from burning solely non-hazardous-waste fuels. 40 C.F.R § 266.112(b)(1) (1992). If the co-processed Bevill wastes are sufficiently similar to ordinary Bevill wastes, the wastes remain exempt from Subtitle C.

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[6] The percentage of coal burned in a BIF may be measured on a "total heat input or mass input basis, whichever results in the greater mass feed rate of coal." 40 C.F.R. § 266.112(a)(1) (1992).

Second, the operator may determine whether toxic compounds are present in the waste in levels that exceed so-called "health based limits"—levels that "could pose a significant risk to human health." 56 Fed. Reg. 7,134 at 7,198 & 7,199 (1992); *see* 40 C.F.R. § 266.112(b)(2) (1992). The first part of the qualitative test need not be conducted if the residue does not exceed the health-based limits. 40 C.F.R. § 266.112(b) (1992). If, however, the residue exceeds the health-based limits, it is exempted from Subtitle C only if it is sufficiently similar to normal residue to pass the first test.

The EPA noted in its statement accompanying the final BIF Rule that it believed that it had struck a "reasonable balance between the terms of the Bevill amendment and other provisions and regulations relating to hazardous waste management." 56 Fed. Reg. 7,134, 7,197 (1991). The agency observed that to disqualify co-processed residues from the Bevill exclusion in cases in which the residue was not "significantly affected" would

> exalt form over substance by barring from Bevill eligibility a residue that was not discernably affected by burning hazardous waste. Given that such material could be exactly the high volume/low hazard residue that Congress told the Agency to study before regulating, EPA does not agree with an interpretation that automatically forecloses it from Bevill status. In addition, use of Bevill devices provides needed treatment capacity for a number of hazardous wastes, and the Agency would be reluctant to adopt an interpretation that discouraged safe processing of hazardous waste. . . .

*Id.* (footnote omitted). The EPA also pointed out that air emissions from Bevill devices, as opposed to combustion residues, would be subject to the requirements of the BIF Rule in all cases; and that the facilities at which Bevill devices were located would be subject to Subtitle C's corrective action requirements in the event hazardous

constituents were released into the environment in ways or quantities not contemplated by the facilities' RCRA permits. *Id.*; *see also American Iron & Steel Inst. v. EPA*, 886 F.2d 390, 393-96 (D.C. Cir. 1989) (holding Bevill wastes are not exempt from RCRA corrective action requirements because those requirements apply to hazardous *constituents*, not merely to hazardous wastes), *cert. denied*, 497 U.S. 1003 (1990).

### 3. *Industry Petitioners' Challenge to the BIF Rule's Interpretation of the Bevill Amendment*

Industry petitioners contend that Congress intended that Bevill wastes be exempt from Subtitle C without regard to the materials burned by the device that produced them.[7] We hold that such an interpretation of the Bevill Amendment would be both irrational and contrary to the law of this circuit as defined by *Solite* and *EDF II*, and accordingly we deny the petitions for review on this point.

Industry petitioners make much of the fact that RCRA section 3004(q) specifically provides that: "Nothing in this subsection shall be construed to affect or impair the provisions of [the Bevill Amendment]." 42 U.S.C. § 6924 (q)(1)(C) (1988). According to Industry petitioners, this clause evinces a congressional intent to exclude from Subtitle C all Bevill wastes that are the product of burning hazardous waste fuels. This argument begs the question, however. We agree that section 3004(q) plainly does not overrule or modify the Bevill Amendment; the question before us is how to integrate the two provisions. We are concerned in this case not with whether the Bevill Amendment retains its vitality, but with what it means.

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[7] The attack on the regulation of ckd was submitted by Industry petitioners Cement Kiln Recycling Coalition; Giant Group, Ltd.; Lafarge Corporation and Solite Corporation. Industry petitioners' challenge to the regulation of combustion residues was submitted on behalf of Chemical Manufacturers Association and Tennessee Eastman Company.

As we noted above, this court held in *EDF II* that the EPA was required to limit Bevill wastes excluded from Subtitle C to those wastes that are high volume/low hazard. In *Solite* we held that the EPA had discretion to define the "high volume" and "low hazard" criteria so long as its definitions were permissible interpretations of the Bevill Amendment. In the instant case a "high volume" criterion is not at issue. However, the two-part "significantly affected" test under the BIF Rule is plainly a means to limit the Bevill exclusion to wastes that are in fact low hazard; we therefore review it under *Chevron* step two.

Neither Industry petitioners nor CASE petitioners challenge the specific parameters the EPA has chosen for "health-based limits," or the test the agency prescribes to determine whether Bevill wastes from devices burning hazardous waste fuel are significantly different from those produced by burning ordinary fuel. Thus, we consider the permissibility of the "significantly affected" test in the absence of any specific challenges to the test itself. Both groups of petitioners argue only that the EPA may not impose such a test at all, not that the test the EPA has promulgated is flawed in any way.

Although the *Solite* and *EDF II* decisions involved only mining wastes under the Bevill Amendment, the analyses in those opinions are wholly applicable to the instant case as well. Industry petitioners suggest that our earlier decisions permitted the EPA to impose hazard and volume criteria only because such guidelines were necessary to implement the mining waste exemption under the Bevill Amendment, which did not specifically enumerate the wastes it covered, but simply referred to "[s]olid waste from the extraction, beneficiation, and processing of ores and minerals." 42 U.S.C. § 6921(b)(3)(A)(ii) (1988). However, we find nothing in our prior decisions to suggest that Congress did not intend to apply the "special waste" framework to all of the wastes listed in the Bevill Amendment—indeed, ckd and combustion residues generated by utilities were among the wastes the EPA suggested for the

special waste category in its 1978 proposal. *See EDF II*, 852 F.2d at 1319.

Further, it simply makes no sense to permit Bevill devices to become inadequately regulated dumping grounds for hazardous materials. According to a source cited by CASE petitioners, cement kilns alone now burn more than twice as much waste as RCRA-permitted incinerators, a figure that Industry petitioners do not attempt to refute. *See* Brief for Petitioners Citizens for a Safe Environment, *et al.* at 18-19. Industry petitioners would have us hold that Congress intended that cement kilns and other Bevill devices may burn *anything*—even spent nuclear fuel, infectious medical waste, or discarded chemical weapons—without the resulting residues being subject to the hazardous waste regulation regime Congress created by enacting Subtitle C. This we are unwilling to do.

The EPA's interpretation of the Bevill Amendment is obviously a reasonable one. Under the BIF Rule, Bevill wastes retain their exemption from Subtitle C so long as they are not "significantly affected" by the hazardous waste fuel burned to produce them, or do not present a hazard to human health and the environment. The BIF Rule is designed to distinguish combustion residues and ckd from materials that are, in effect, very different substances. Quite simply, if ckd from co-processing hazardous waste fuels is "significantly affected," it is no longer just ckd, but ckd plus the products of combustion of hazardous waste. We therefore hold that the BIF Rule is a permissible interpretation of the Bevill Amendment's low hazard criterion.

4. *CASE Petitioners' Challenge to the BIF Rule's Interpretation of the Bevill Amendment*

a. *CASE Petitioners' Standing*

Industry intervenors contend that CASE petitioners lack standing to challenge the BIF Rule's interpretation of the

Bevill Amendment.[8] We need not linger long on this issue as we hold that CASE petitioners plainly do have standing.

To support their standing argument, Industry intervenors attempt to rely on this court's decisions in *Hazardous Waste Treatment Council v. EPA*, 861 F.2d 270 (D.C. Cir. 1988) (*"HWTC I"*), and its companion case, *Hazardous Waste Treatment Council v. EPA*, 861 F.2d 277 (D.C. Cir. 1988), *cert. denied*, 490 U.S. 1106 (1989) (*"HWTC II"*). In *HWTC II* this court held that the Hazardous Waste Treatment Council ("HWTC"), a trade association of firms engaged in the treatment of hazardous waste and one of the CASE petitioners in this case, lacked standing to challenge the EPA's then-existing section 3004(q) regulations governing the burning of hazardous waste as fuel. HWTC contended in that case that it had standing because the alleged laxity of the EPA's regulatory scheme would injure its members by diminishing the market for their waste management services. Among the injuries HWTC alleged was that because the EPA at that time exempted all Bevill residues from Subtitle C, HWTC's members who operated hazardous waste incinerators were at a competitive disadvantage when selling waste incineration services because they were forced to bear the costs of disposing of their combustion residues in compliance with Subtitle C. *See HWTC II*, 861 F.2d at 281. We found these allegations inadequate to establish standing. *See id.* at 280-85.

In the instant case, Industry intervenors contend that HWTC attempts to redress the same injury found inadequate for standing in *HWTC II*. This argument is to no avail, however. Even assuming *arguendo* that Industry

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[8] This standing challenge was offered by Industry intervenors American Mining Congress, Cyprus Miami Mining Corporation, Edison Electric Institute, Solite Corporation and Tennessee Eastman Company. The EPA did not contest CASE petitioners' standing.

intervenors are correct as to HWTC, the environmental organizations who are also among the CASE petitioners clearly do have standing. As was the case in *HWTC I*, because we find that the environmental organizations among the CASE petitioners have standing, the question of HWTC's standing raises a moot issue. *See HWTC I*, 861 F.2d at 273 (citing *Bowen v. Kendrick*, 487 U.S. 589, 620 n.15 (1988)).

Industry intervenors argue that the environmental organizations among the CASE petitioners lack standing because the EPA's health-based limits are designed to ensure protection of human health and the environment, and so petitioners cannot allege an actual injury. We disagree. The Supreme Court recently held that "the irreducible constitutional minimum of standing contains three elements." *Lujan v. Defenders of Wildlife*, 112 S. Ct. 2130, 2136 (1992). First, a petitioner must have suffered an "injury in fact" that is both concrete and particularized, and actual or imminent. Second, the injury must be fairly traceable to the challenged action of the defendant. Third, "it must be likely, as opposed to merely speculative, that the injury will be redressed by a favorable decision." *Id.* (internal quotation omitted). CASE petitioners have alleged, and Industry intervenors do not dispute, that some of their members live in communities near Bevill devices of various types. In *HWTC I* we upheld the standing of an environmental group which asserted that the EPA's failure to regulate used oil as a Subtitle C hazardous waste constituted an injury-in-fact to its members living in communities potentially subject to incidents resulting from mismanagement of used oil. 861 F.2d at 273. Further, in that case this court also held that in the event the environmental group won its lawsuit, remanding the used oil regulations to the EPA for reconsideration of its subtitle C listing decision would be "likely to redress the injuries alleged." *Id.*

The instant case presents a standing inquiry identical in all relevant respects to the allegations we held adequate

for standing in *HWTC I*. The environmental groups among the CASE petitioners allege that the BIF Rule is an unlawful interpretation of the Bevill Amendment which exposes their members to greater risks than they would face if all Bevill wastes were regulated under Subtitle C. If the EPA were required to regulate Bevill wastes as Subtitle C hazardous wastes, those wastes would be subject to a more stringent regulatory regime than the current BIF Rule imposes, providing greater protection to petitioners' members.

Because the environmental organizations among the CASE petitioners have standing, we hold that the CASE petitioners as a group also have standing to challenge the BIF Rule.

b. *CASE Petitioners' Interpretation of the Bevill Amendment*

CASE petitioners assert that the Bevill Amendment exempts from Subtitle C only Bevill wastes produced by facilities burning purely non-hazardous-waste fuel. As we discussed at length above, Congress intended the Bevill Amendment to enact the high volume/low hazard "special waste" concept. The plain language of RCRA section 3004(q) makes clear that Congress knew when it added that section that Bevill devices burned hazardous waste, and suggests that it expected they might be subject to a different regulatory regime than that imposed on other BIFs. Given these facts, we cannot hold that the legislature clearly intended automatically to remove the Bevill exemption for all Bevill wastes generated from co-processing hazardous wastes.

RCRA section 3004(q)(2)(C)(i) provides that "no fuel which contains any hazardous waste may be burned in any cement kiln which is located within" a city with a population of over five hundred thousand, unless the kiln complies with RCRA's incinerator regulations. 42 U.S.C. § 6924(q)(2)(C)(i) (1988). This provision is incon-

trovertible evidence that Congress knew cement kilns and other Bevill devices burned hazardous waste. Further, the fact that Congress singled out cement kilns in large cities, but did not address other types of boilers or industrial furnaces that burn hazardous waste, suggests that the legislature believed that cement kilns might be subject to a different regulatory regime than other BIFs, as there would be no reason to assume that if cement kilns were subject to the BIF Rule they would present hazards distinguishable from other devices burning similarly hazardous wastes.

All the time Congress enacted section 3004(q) it was aware that Bevill devices burned hazardous waste. In that section it specifically reaffirmed the Bevill Amendment, while at the same time ordering the EPA to regulate facilities burning hazardous waste as fuel. Nevertheless, nowhere in section 3004(q), or anywhere else in RCRA, does Congress indicate how it wished the EPA to integrate the potentially conflicting provisions at issue in this case. Under these circumstances, we cannot hold that the legislature has "directly addressed the precise question at issue." *Chevron*, 467 U.S. at 843. The BIF Rule provides for the continued vitality of the Bevill Amendment, as section 3004(q) requires, by ensuring that high volume/low hazard criteria remain the standard for exemption of Bevill wastes from Subtitle C. At the same time, the rule recognizes that Bevill wastes that are not low hazard do come within section 3004(q)'s broad mandate that the EPA regulate the burning of hazardous waste. This result is a permissible interpretation of both section 3004(q) and the Bevill Amendment.

c. *CASE Petitioners' Challenge to the EPA's Exemption of Bevill Wastes from RCRA's Land Disposal Restrictions*

CASE petitioners also challenge the EPA's determination that Bevill wastes that pass the BIF Rule's "signifi-

cantly affected" test are not subject to RCRA's land disposal restrictions ("LDR"). The LDR prohibit the landfilling of Subtitle C hazardous wastes unless the wastes are treated according to specified standards, or disposed of in a land disposal facility that meets RCRA's "no migration" standard. *See generally Chemical Waste Management, Inc. v. EPA*, 976 F.2d 2, 8-9 (D.C. Cir. 1992), *cert. denied*, 113 S. Ct. 1961 (1993). Because the residues from the incineration of hazardous wastes remain hazardous waste by virtue of the derived-from rule, they ordinarily must comply with the LDR. However, because the BIF Rule provides that Bevill wastes that are not "significantly affected" are exempt from Subtitle C, these wastes are not subject to the LDR by virtue of a 1986 EPA regulation which provides that wastes that are not Subtitle C hazardous wastes need not comply with RCRA's land disposal restrictions. *See* 40 C.F.R. § 268.1(b) (1992) (non-hazardous wastes not subject to LDR); *id.* § 261.4 (b)(4), (7), (8) (Bevill wastes not hazardous waste unless "significantly affected").

CASE petitioners argue that the LDR attach irrevocably to hazardous wastes at the moment they are generated. For example, waste solvents that are hazardous wastes ordinarily must be disposed of in keeping with the LDR. CASE petitioners contend that these same solvents should not be able to evade the LDR by being burned in a cement kiln, thereby potentially becoming Bevill wastes exempt from Subtitle C rather than "treated" hazardous waste. In addition, CASE petitioners argue that they were not given adequate notice or opportunity to comment on the EPA's decision to exclude some co-processed Bevill wastes from the LDR.[9] The EPA counters that the LDR issue

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[9] *Chemical Waste Management* also considered a challenge by the Natural Resources Defense Council ("NRDC"), one of the CASE petitioners, to a regulation providing that Bevill wastes were exempt from the LDR. The court vacated the LDR exemption on notice and comment grounds and remanded it for consideration in an ongoing rulemaking. 976 F.2d at 33 n.20. In response to the

was never at issue in the BIF rulemaking because the agency did not reopen the matter, but reopened only the question of whether the agency should exempt Beville wastes generated by co-processing hazardous waste from Subtitle C. According to the EPA, Bevill wastes that are not "significantly affected" are simply exempt from the LDR by operation of regulations that were in place before the BIF Rule was even proposed. The agency notes further that it has initiated a separate rulemaking to deal with the question of the LDR's applicability to co-processed Bevill wastes. *See* 56 Fed. Reg. 55,160, 55,166 (1991). Because, we uphold the EPA's decision to exempt some Bevill wastes from Subtitle C, we also hold that those residues that are excluded are not subject to the LDR as those provisions by their plain language do not apply to materials that are not hazardous waste. CASE petitioners' argument that they were not provided adequate notice of, and opportunity to comment on, the LDR is thus moot, because the BIF Rule did not re-open or modify the LDR, but simply established the circumstances under which Bevill wastes would be subject in Subtitle C. The fact that the LDR do not apply to non-Subtitle C wastes is the result of the EPA's 1986 regulation, not a consequence of the BIF Rule that the EPA was required to address in the BIF rulemaking.

CASE petitioners base their argument that the EPA may not exempt hazardous wastes burned in Bevill devices from the LDR on this court's decision in *American*

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vacation of the LDR exemption in *Chemical Waste Management*, the EPA asserted that its 1986 regulations, specifically 40 C.F.R. §§ 261.11(a) and 268.1(b), provided that wastes excluded from the definition of "solid waste" or "hazardous waste" were exempt from the LDR. Because the wastes exempted by these regulations included Bevill wastes, the EPA maintained that the vacation of the LDR exemption restored the *status quo ante*, which happened to dictate an identical result. Thus, despite NRDC's "victory" in *Chemical Waste Management*, Bevill wastes which are not Subtitle C hazardous wastes remained exempt from the LDR.

*Petroleum Institute v. EPA*, 906 F.2d 729, 740-42 (D.C. Cir. 1990) ("*API*"), which held that the EPA erred in assuming that RCRA required it to cease regulating metal slag as a hazardous waste when it arrived at a reclamation facility. In that case, the EPA had assumed that the slag became a raw material rather than a "solid waste" when it was used for materials recovery. *API* strongly suggested, but did not decide, that the EPA could not reconcile its decision to cease regulating slag at the point of metals reclamation with RCRA's "cradle-to-grave" regulatory structure. *Id.*

CASE petitioners assert that *API* requires the EPA unstintingly to regulate hazardous wastes under Subtitle C. We need not resolve this sweeping question in order to decide this case, however. Whatever RCRA might require in the case of other solid wastes, Congress has mandated that high volume/low hazard Bevill wastes have a special status pending completion of the Bevill studies. It is permissible for the EPA to find that one aspect of that special status is exemption from the LDR. The EPA's position on this issue is a simple syllogism: The LDR apply only to Subtitle C hazardous wastes; Bevill wastes that are not "significantly affected" are not hazardous wastes; therefore, Bevill wastes that are not hazardous waste are not subject to the LDR.[10] Because we uphold the EPA's determination that Bevill wastes produced by co-processing hazardous waste are in some circumstances exempt from Subtitle C, we also uphold the agency's decision to exempt non-hazardous Bevill wastes from the LDR

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[10] We hold that this syllogism is a *permissible* interpretation of the Bevill Amendment, not that the EPA is required to so read the statute. In its notice of proposed rulemaking requesting comments on the possibility of subjecting Bevill wastes to the LDR, the EPA suggested that our holding in *American Iron & Steel Institute*, 886 F.2d at 395-96, might permit the agency to apply the LDR even to Bevill wastes not subject to Subtitle C. 56 Fed. Reg. 55,160, 55,166 (1991). The permissibility of this alternative interpretation is not before us in this case, and we express no opinion as to that question.

as a permissible construction of the Bevill Amendment and of Subtitle C.

C. *The BIF Rule's Regulation of Air Emissions*

Several of the Industry petitioners [11] contend that the BIF Rule exceeds the EPA's statutory authority under RCRA because it regulates materials that are not "hazardous waste." The BIF Rule establishes a complex set of air emissions controls for toxic metals, chlorine, and hydrogen chloride emitted from BIFs burning hazardous waste fuel. The rule creates a three-tiered system of regulation in which the levels of emissions and feed rates allowed are proportional to the degree of sampling and analysis a BIF operator performs on the BIF's emissions. *See generally* 56 Fed. Reg. 7171-80 (1991). An owner or operator has the option of satisfying the rule by demonstrating compliance with any one of the three tiers. The first tier of controls assumes that all of the regulated materials fed into the BIF are emitted into the air, without regard for any pollution control devices that may be present, and so provides stringent limits on the rate at which the metals, chlorine, and hydrogen chloride may be fed into the unit. The operator demonstrates compliance by analyzing the toxic content of the materials burned, rather than by measuring actual air emissions. Under the second tier, the BIF owner or operator demonstrates compliance through emissions testing. The third tier permits an owner or operator to conduct both emissions testing and site-specific dispersion modeling (which takes into account actual dispersion conditions at the facility) to show that the emissions do not exceed acceptable levels. The EPA expects most facilities to comply with the BIF Rule via the third tier. 56 Fed. Reg. 7173 (1991).

Industry petitioners challenge the three-tiered approach because it obligates operators to measure either the rele-

[11] Chemical Manufacturers Association, Marine Shale Processors, Inc., Tennessee Eastman Company, and the American Petroleum Institute.

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vant constituents of, or the air emissions from, *all* fuels fed into the BIF and not just those which are hazardous waste. The EPA responds that RCRA enables the agency to regulate facilities that burn hazardous waste for fuel, not merely the hazardous waste components of the fuel itself. Because both the EPA and Industry petitioners base their arguments on the first prong of *Chevron*, arguing that Congress has directly spoken to the precise question at issue, we begin by examining the relevant statutory language. Section 3004(q) of RCRA authorizes the EPA to "promulgate regulations establishing . . . standards applicable to the owners and operators of *facilities* which burn, for purposes of energy recovery, any fuel [which is produced from hazardous waste or from hazardous waste and any other material] . . . or any fuel which otherwise contains any hazardous waste. . . ." 42 U.S.C. § 6924 (q)(1)(B) (emphasis added). In addition, § 3004(a) of RCRA directs the EPA to "promulgate regulations establishing such performance standards, applicable to owners and operators of *facilities for the treatment*, storage, or disposal of hazardous waste . . as may be necessary to protect human health and the environment." 42 U.S.C. § 6924(a) (emphasis added).

We agree with the EPA that the plain language of RCRA defeats Industry petitioners' contentions. First, § 3004(q) applies to *facilities*, not just fuels, and therefore the EPA may regulate BIF owners or operators who elect to burn "any fuel which . . . contains any hazardous waste." 42 U.S.C. § 6924(q)(1)(B). No BIF is required to burn hazardous waste fuel, but if it chooses to do so, § 3004(q) permits the EPA to monitor total feed rates and air emissions; if a BIF elects not to burn hazardous waste, then the BIF Rule would not apply. Second, § 3004(a) allows the EPA to regulate owners and operators of facilities that "treat" hazardous waste. As discussed above, *supra* at 13 n.2, for RCRA purposes, burning hazardous waste is considered "treatment" of hazardous waste. Therefore, §§ 3004(a) and (q) allow the

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EPA to regulate facilities that burn non-waste fuels if those fuels are being burned with hazardous waste.

Although they make a *Chevron* step I argument, Industry petitioners do not rely on RCRA's statutory language. Instead, they focus on this court's decision in *American Mining Congress v. EPA*, 824 F.2d 1177 *American Mining Congress v. EPA*, 824 F.2d 1177 (D.C. Cir. 1987) [hereinafter *AMC I*], interpreting RCRA's definitional section, 42 U.S.C. § 6903. Section 6903 defines "hazardous waste" as a subset of "solid waste." 42 U.S.C. § 6903(27). *AMC I* held that the EPA does not have jurisdiction under RCRA to regulate materials reused for materials recovery within an ongoing production process because such materials were never discarded and thus are not "solid waste." Industry petitioners reason that the EPA lacks jurisdiction under RCRA to monitor the constituents of non-waste fuels burned with hazardous waste because these co-processed fuels too are not "hazardous waste." However, the holding of *AMC I* is not dispositive here. *AMC I* involved an altogether different facet of waste disposal governed by a different statutory section, *i.e.*, the scope of the RCRA term "solid waste," and not the EPA's right under §§ 3004(a) and (q) to regulate facilities handling non-waste materials when the materials are co-processed with fuel that is unquestionably "hazardous waste" subject to RCRA. As discussed above, the plain language of §§ 3004(a) and (q) clearly authorizes the EPA to regulate facilities that burn a mixture of hazardous waste and non-waste.

Even assuming that the language of RCRA does not unambiguously permit regulation of non-waste fuels when they are co-processed in a facility burning hazardous waste, the EPA's decision to regulate such non-waste is a permissible construction of the statute under *Chevron* step II. While the EPA is not free to regulate non-hazardous raw materials at will, in this case the agency has demonstrated an adequate nexus between the three-tiered controls and the management of hazardous waste. *See gen-*

*erally In the Matter of BP Chemicals America, Inc.*, 1991 RCRA LEXIS 23. *9 (Aug. 20, 1991). The EPA persuasively argues that the BIF Rule's regulation of the content of non-waste fuels burned in a BIF along with hazardous waste is vindicated by the inherent difficulty in differentiating between the molecules of emissions generated by the hazardous waste components of BIF fuel and those generated by the non-waste components. *See* 56 Fed. Reg. 7144. The health and environmental effects of BIF emissions from the mix are the same whatever the source of an individual molecule. The EPA also notes that because compliance with the BIF Rule is often demonstrated by monitoring emissions during a trial burn, feed rates of *all* inputs to the unit must be continuously controlled to assure that the results of the trial burn are representative of actual operations. Were the EPA to allow BIF operators to demonstrate compliance on the basis of one trial burn alone, the operators might burn hazardous waste along with less toxic raw materials during the final burn and then increase the toxicity of the raw materials in later burns. *See* 56 Fed. Reg. 7144 (1991). Finally, the EPA claims that limitations must be placed on non-waste feeds because co-processing of hazardous waste and raw materials can make the commingled emissions more toxic than the sum total of the individual emissions from the hazardous and non-hazardous materials alone. *See* 56 Fed. Reg. 7157 (1991); *see also* 56 Fed. Reg. 7176 (1991) (BIF Rule limits metal feed rate for both hazardous waste and non-waste fuels because when added to emissions from hazardous waste, noncarcinogenic materials can cause a maximum exposed individual ("MEI") concentration that exceeds threshold level for protecting human health). Thus the EPA's requirement that BIF owners and operators monitor the constituents of all their fuel inputs when they burn both hazardous waste and non-waste is a reasonable application of its RCRA authority under §§ 3004(a) and (q).

Industry petitioners argue, however, that the EPA failed to address precisely the alternatives they posed to non-

waste monitoring. A rulemaking will be overturned as arbitrary and capricious if "the EPA has failed to respond to specific challenges that are sufficiently central to its decision." *International Fabricare Inst. v. EPA*, 972 F.2d 384, 389 (D.C. Cir. 1992) (citing *American Mining Congress v. EPA*, 907 F.2d 1179, 1191 (D.C. Cir. 1990)); *accord Motor Vehicles Mfrs. Ass'n v. State Farm Mut. Life Ins. Co.*, 463 U.S. 29, 48 (1983) (alternative ways of achieving objectives of statute should be addressed and reasons given for abandonment). During the BIF rulemaking, Industry petitioners suggested the following three ways to limit regulation of a BIF's air emissions to those attributable to the burning of hazardous waste: (1) perform a test burn using non-waste fuel to determine the removal efficiencies of the BIF unit's air pollution control devices (APCDs), and then apply those removal efficiencies to the emissions from the burning of hazardous waste: (2) allow a BIF owner or operator to rely on the conservative removal efficiencies already specified by the EPA for various types of APCDs and then calculate backwards to determine the allowable metals content for the hazardous waste feed; and (3) conduct baseline tests to characterize the relationship between waste feed composition (*i.e.*, proportion of hazardous waste in the fuel) and removal efficiency. *See Comments of the Chemical Manufacturers Ass'n on EPA's Supplement to the Proposed BIF Rule, reprinted in* Joint Appendix ("J.A.") at 667-68. These proposals, however, occupied only three sentences of a voluminous notice and comment record and were not supported by any evidence regarding their effectiveness at protecting human health and the environment.

Although the EPA did not explicitly respond to the specific suggestions of Industry petitioners, the agency did, as a general matter, explain the reasons underlying its decision to regulate non-waste fuels when they are co-processed with hazardous waste. As discussed above, the BIF Rule set forth three justifications for regulating non-waste fuels when they are burned with hazarodus waste

fuels: (1) the inadequacy for compliance purposes of test burns that do not impose limitations on the toxicity content of non-waste fuels, (2) the difficulty of differentiating between toxic air emissions from the burning of non-waste and hazardous waste, and (3) the phenomenon that co-processing non-waste and hazardous waste in a BIF can result in more toxic emissions. *See* 56 Fed. Reg. 7144 (1991). Implicit in the EPA's discussion of the problems embedded in regulating hazardous waste alone is a rejection of Industry petitioners' alternative proposals. In light of the sketchy nature of these alternative proposals, we find that this portion of the BIF rulemaking (establishing the three-tiered system of air emissions controls) survives arbitrary and capricious review.

The BIF Rule's regulation of non-waste fuels is well within RCRA's grant of authority to the EPA to regulate facilities burning hazardous waste. Due to the difficulties associated with regulating emissions from hazardous waste fuels only, the EPA has reasonably decided to monitor the constituents of, and the air emissions from, all fuels burned in a BIF facility that burns hazardous waste. Although it would have been instructive for the EPA to have addressed more precisely the three proposals suggested by Industry petitioners, we conclude that the agency's general discussion of its decision to regulate non-waste adequately set forth its reasons for rejecting the proposals.

D. *Regulation of Products of Incomplete Combustion*

1. *Background*

Under RCRA, the EPA must develop standards to control emissions from burning hazardous waste fuels "as may be necessary to protect human health and the environment." RCRA § 3004()q)(1); 42 U.S.C. § 6924(q)(1). In response to this mandate, the EPA proposed standards for emissions of toxic organic compounds in the BIF rulemaking. The BIF Rule, which was issued on February

21, 1991, imposes three requirements on BIFs burning toxic organics: (1) a 99.99% destruction removal efficiency ("DRE"); (2) good combustion conditions in kilns and other regulated BIFs so as to control products of incomplete combustion ("PICs"); and (3) in certain cases, health risk assessments. *See* 56 Fed. Reg. 7,134, 7,146-71 (1991) ("Final Rule").

Here, Industry petitioners Lone Star Industries, Inc., Holnam, Inc., Safety-Kleen Corp., and the Cement Kiln Recycling Coalition ("cement kiln petitioners") challenge the second of these requirements as applied to wet process kilns. Cylindrical in shape, a wet kiln rotates on its own axis and is slightly inclined so that raw materials introduced at the top end travel slowly to the lower end. The raw materials (such as clay, shale, limestone, and marl) are mixed in a slurry form and calcined, i.e., heated to a high temperature, as the slurry slides down the kiln towards the furnace at the lower, or "hot" end. Significantly, these raw materials contain widely varying amounts of organic material that are driven off as the slurry mixture calcines.

The furnace at the hot end of the wet kiln requires large amounts of fuel, which can be powdered coal or other fossil fuel or, alternately, high-BTU hazardous waste. One benefit of using hazardous waste in this manner is immediately obvious: It takes the place of scarce fossil fuels. Another benefit is that the high furnace temperatures (upwards of 2,500 degrees Fahrenheit) destroy the hazardous organic compounds contained in the waste. The drawback is that the burning of hazardous waste results in the creation of incompletely burned organic compounds (i.e., PICs) that are emitted from the upper end of the kiln.

A kiln's utility as a means of destroying hazardous wastes turns on its ability to fully destroy them. In practice, destruction of hazardous wastes in the fuel is a function of the combustion efficiency of the kiln; Under poor

conditions of efficiency, the principal organic hazardous constituents ("POHCs") of the toxic organic compounds contained in the hazardous waste fuel will be only partially broken down, thereby increasing the production of PICs. The health effects of PIC emissions are unclear—some are known carcinogens, other may be, and others are undetectable. *See* Final Rule, 56 Fed. Reg. 7,150, col. 1. This uncertainty led the EPA to regulate PICs in the BIF Rule, for "[g]iven the limited information about the hazards that PIC emissions may pose, EPA believes it is prudent to require that boilers and industrial furnaces operate at a high combustion efficiency to minimize PIC emissions." *Id.*

The EPA chose to monitor carbon monoxide ("CO") and total hydrocarbon ("THC") levels as indicators of combustion efficiency and required that one of three emissions standards be met: (1) a stack or by-pass duct CO level not to exceed 100 ppmv, 40 C.F.R. § 266.104(b) ("Tier I standard"); (2) a stack or by-pass duct CO level above 100 ppmv so long as the stack or by-pass duct levels of THC are below 20 ppmv, § 266.104(c) ("Tier II standard"); or (3) for those industrial furnaces not having a by-pass duct (i.e., wet kilns), meeting an alternative THC limit that ensures that flue gas hydrocarbon ("HC") and CO concentrations when burning hazardous waste fuels are not greater than when not burning hazardous waste, § 266.104(f) ("Tier III standard").

The EPA's rationale for monitoring CO as an indicator of combustion efficiency is based on the following understanding of the mechanics of the combustion process:

> In the first stage of the combustion of hazardous waste fuel, the POHCs thermally decompose in the flame to form other, usually smaller, compounds termed products if [sic] incomplete combustion. In this first stage of combustion, these PICs also decompose to form CO.

> The second stage of combustion involves the oxidation of CO to $CO_2$ (carbon dioxide). The CO to $CO_2$ step is the slowest (rate-controlling) step in the combustion process because CO is considered to be more thermally stable (difficult to oxidize) than other intermediate products of the combustion of hazardous waste constituents. . . .
>
> Thus, in the waste combustion process, the "destruction" of POHCs is independent of flue gas CO levels. CO flue gas levels cannot be correlated with DREs for POHCs, and may also not *correlate* well with PIC destruction. Although some emissions data indicate a weak correlation between CO and PICs, the data generally indicate that there is a relationship between the two parameters: When CO is low, PIC emissions are relatively low. The converse may not hold: when CO is high, PICs may or may not be high.
>
> Low CO is an indicator of the status of the CO to $CO_2$ conversion process, the last rate-limiting oxidation process. Because oxidation of CO to $CO_2$ occurs after the destruction of a POHC and its (other) intermediates (PICs) the absence of CO is a useful indication of POHC and PIC destruction.

Final Rule, 56 Fed. Reg. 7,150, col. 2 (emphasis in original).

The choice of CO as an indicator of combustion efficiency creates a technical problem, that of restricting CO measurement to the CO emitted by the hazardous waste fuel. This is well-nigh impossible in wet kilns, for as the slurry slides down the kiln, the organic materials in the slurry combust and CO is created ("slurry off-gases"). These CO emissions are unrelated to the CO produced by the combustion of hazardous waste at the lower end of the kiln ("combustion off-gases"). Moreover, there is no way of isolating the two chemical processes because, unlike dry kilns, which have a by-pass duct that permits the

diversion of the kiln off-gas into a separate flue before it is united with the emissions generated by the raw materials, in a wet kiln the combustion off-gases combine with emissions from the slurry, and both exit from the upper end of the kiln. Thus background emissions of CO attributable to the oxidation of the raw materials will enter into the measurement of CO emissions and may prevent wet kilns from meeting the Tier I standards regardless of their combustion efficiency.

Recognizing this problem, on October 26, 1989, the EPA proposed to add a second alternative emissions standard. *See* 54 Fed. Reg. 43,718, 43,722-27 (1989) (EPA's first supplement to the proposed BIF Rule ("First Supplement")). The CO standard was to be retained (the Tier I standard), but an alternative standard was to be added (the Tier II standard). The Tier II standard was to be either technology-based (limits on THC emissions) or health-based (the facility would have to demonstrate that PIC emissions posed an acceptable risk to the maximally exposed individual). *See* 54 Fed. Reg. 43,722, col. 2. Under the technology-based standard, THC emissions were not to exceed 20 ppmv. 54 Fed. Reg. 43,723, col. 3; 40 C.F.R. § 266.104(c). This standard was chosen on the basis of the data for hazardous waste incinerators and BIFs operating under good combustion conditions, as well as the EPA's use of risk assessment methodology to show a 20 ppmv level was protective of human health. 54 Fed. Reg. 43,723, col. 3.

Unfortunately, wet process kilns may be incapable of meeting the technology-based Tier II standards for the same reason that prevents them from meeting the Tier I standard. Indeed, oxidation of the organic materials contained in the slurry mixture produces not only CO, but also HC. These background emissions are independent of the emissions from the combustion of hazardous wastes at the lower end of the kiln. First Supplement, 54 Fed. Reg. 43,724, col. 1. Thus neither CO nor THC emissions are an accurate indicator of the combustion efficiency of wet

kilns due to the impossibility of isolating the two combustion processes occurring within the kiln. Reconsidering this problem, the EPA requested comments on the possibility of different THC limits as well as the feasibility of a third standard—a site-specific limit "where THC levels when burning hazardous waste would be limited to baseline THC levels without burning hazardous waste." 54 Fed. Reg. 43,724, col. 1. The EPA continued discussions with the affected industry well after the end of the comment period. Final Rule, 56 Fed. Reg. 7,155 n.28.

In the final BIF Rule, the EPA adopted the Tier I and the technology-based Tier II standards and also promulgated a Tier III standard. This last was aimed at the "6 to 10 [wet process kilns that] may not be able to comply with the HC limit of 20 ppmv even though they generate minimal HC from sources other than raw materials." 56 Fed. Reg. 7,155, col. 3, The Tier III standard is essentially a waiver provision that allows the EPA to formulate alternative CO and THC limits on a case-by-case basis if operators of wet kilns can meet certain conditions. 40 C.F.R. § 266.104(f)(1). To obtain a Tier III waiver, the wet kiln operator must, *inter alia*, (1) demonstrate that flue gas levels of CO and THC do not increase over baselines measured when the kiln is fired by non-hazardous fuels in a manner designed to minimize hydrocarbon emissions, (2) identify POHCs in the kiln's emissions, and (3) conduct a site-specific risk assessment to demonstrate that the maximum annual average ground level concentrations do not exceed listed levels. 40 C.F.R. §266.104(f)(3). It is this Tier III standard that bears the brunt of the cement kiln petitioners' challenges to the PIC standards. They argue both that the EPA gave insufficient notice and opportunity for comment on the Tier III standard and that each of the three tiers is arbitrary and capricious as applied to wet process kilns.

2. *Did the EPA Provide Adequate Notice and Opportunity for Comment on the Tier III Hydrocarbon Standard?*

The cement kiln petitioners contend that the EPA failed to accord adequate notice and opportunity for comment on the Tier III standard. The validity of this challenge turns on the relationship between the proposed regulations and the Tier III standard contained in the final BIF Rule. *See Shell Oil Co. v. EPA*, 950 F.2d 741, 747 (D.C. Cir 1991) ("The relationship between the proposed regulation and the final rule determines the adequacy of notice."). As we stated in *Shell Oil*, adequate notice is given when "the final rule is a 'logical outgrowth' of the one proposed." *Id.* at 747. Nevertheless, the "EPA undoubtedly has authority to promulgate a final rule that differs in some particulars from its proposed rule." *Small Ref. Lead Phase-Down Task Force v. EPA*, 705 F.2d 506, 546 (D.C. Cir. 1983).

The EPA certainly raised the possibility of a specific standard for wet kilns. In the First Supplement, the agency explicitly recognized that "[p]reheater and precalciner cement kilns, for example, may not be able to readily achieve such a low THC concentration for the same reason that they typically cannot achieve CO levels below 100 ppmv." 54 Fed. Reg. 43,724, col. 1. It thus called for comments on

> (1) The types of industrial furnaces for which a THC level of 20 ppmv is representative of good combustion conditions; (2) whether alternative THC limits may be more appropriate for certain industrial furnaces; and (3) whether an approach to identify a site-specific THC limit representative of good operating practices may be feasible (e.g., where THC limits when burning hazardous waste would be limited to baseline THC levels without burning hazardous waste.). In support of comments, we request data on emissions of CO and THC under baseline

> and hazardous waste burning conditions, including characterization of the type and concentration of individual organic compounds omitted.

*Id.* This placed the cement kiln petitioners on notice that a non-hazardous waste fuel THC baseline standard might be adopted for wet kilns. Moreover, the EPA held repeated meetings with these petitioners as well as individual cement kiln operators to discuss an alternative hydrocarbon limit for cement kilns burning hazardous waste fuel. 56 Fed. Reg. 7,155 & n.28.

While the cement kiln petitioners may have had notice of the possibility of a THC standard for wet kilns, we are hard pressed to find any precursor to the dual-baseline/health-based emissions testing standard actually embodied in the Tier III provision in any of the three proposed regulations preceding the final rule. *See* Proposed Rule, 52 Fed. Reg. 16,982, 16,997-17,000 (1987); First Supplement, 54 Fed. Reg. 43,718, 43,721-28; second supplement to the proposed rule, 55 Fed. Reg. 17,862, 17,880-89 (1990) ("Second Supplement"). The EPA contends that the rulemaking proposals disclosed the central elements of the final Tier III standard and attempts to predicate notice of the Tier III standard on mentions of its component parts.

To this end, the EPA cites its determination in the First Supplement that THC could serve as a good indicator of combustion efficiency, 54 Fed. Reg. 43,722-24, which it reiterated in the Second Supplement, 55 Fed. Reg. 17,884-86. The EPA also points to its call for comments on the possibility of a site-specific limit of THC levels to those experienced when burning non-hazardous waste fuel, 54 Fed. Reg. 43,724, col. 1, reiterated in the Second Supplement, 55 Fed. Reg. 17,885, col. 3. It also cites the determination that both CO and THC could be measured on the basis of hourly rolling averages, 54 Fed. Reg. 43,726-27, and the suggestion that a THC standard might be based on generic risk assessment. 54 Fed. Reg. 43,723, col. 1.

Nowhere in the proposed rulemakings, however, does the agency indicate it is contemplating the possibility of dual CO and THC baselines. This omission is critical because notice of individual parts of a proposed rule is not necessarily notice of the whole. One purpose of notice is to promote informed decisionmaking, and comments addressed to one specific component part of the standard do not necessarily bear on the viability of Tier III as a whole. *See Fertilizer Inst. v. EPA*, 935 F.2d 1303, 1312 (D.C. Cir. 1991) ("Because comments appropriate to a determination of the hazards of radionuclides would not necessarily be appropriate to a determination of the hazards of entities using or producing radionuclides, we conclude that the notice published by the EPA did not provide interested parties with an adequate opportunity to comment."). Here, more notice should have been given of the form of the Tier III standard, for while the "logical outgrowth" standard does not require the agency to assiduously lay out every detail of a proposed rule for comment, it does require that the "agency . . . publish notice of either the substance of a proposed rule or a 'description of the subjects and issues' covered by a proposed rule." *Id.* at 1310-11 (quoting 5 U.S.C. § 553(b)(3)). Such a description must "provide sufficient detail and rationale for the rule to permit interested parties to participate meaningfully." *Id.* at 1311 (internal quotation marks and citations omitted).

It is the possibility of meaningful participation that is lacking here, for while the EPA proposed individual elements of the Tier III standard separately, the component parts were never collected together in such a fashion as to enable the parties to anticipate and adequately comment on the ultimate Tier III standard. The agency did request data on "emissions of CO and THC under baseline and hazardous waste burning conditions," First Supplement, 54 Fed. Reg. 43,724, col. 1, but this gives no indication that a dual baseline was contemplated and could just as easily have been a call for data to support

the Tier I and Tier II standards. Notice of these two standards was exhaustive, while the cement kiln petitioners were only on notice that a site-specific THC standard was contemplated for wet process kilns.

As we have stated before, general notice that a new standard will be adopted affords the parties scant opportunity for comment. *Small Ref. Lead Phase-Down Task Force,* 705 F.2d at 549. The agency's obligation is more demanding—it must "describe the range of alternatives being considered with reasonable specificity. Otherwise, interested parties will not know what to comment on, and notice will not lead to better-informed agency decisionmaking." *Id.* Here, the "range of alternatives" described by the EPA did not include the ultimate standard; nor can the ultimate standard be considered a "logical outgrowth" of the individual component parts cited by the EPA. Ultimately, the EPA simply failed to give interested parties sufficient notice of the form that the Tier III standard might take, undermining the aims of meaningful participation and informed decisionmaking. *Id.* at 547 ("[N]otice improves the quality of agency rulemaking by ensuring that agency regulations will be tested by exposure to diverse public comment." (internal quotation marks omitted)).

The EPA makes much of the comments submitted on issues that were to become critical parts of the final rule, as well as the meetings it held with industry. While we have noted that insightful comments may be reflective of notice and may be adduced as evidence of its adequacy, *see, e.g., Shell Oil,* 950 F.2d at 751, we have rejected bootstrap arguments predicating notice on public comments alone. Ultimately, notice is the agency's duty because "comments by members of the public would not in themselves constitute adequate notice. Under the standards of the APA, notice necessarily must come—if at all—from the Agency." *Id.* (internal quotation marks and citations omitted). Here, moreover, the comments submitted by the parties undercut the EPA's argument for

they only go to the individual component parts of the final Tier III standard. Not one contemplates anything more than a standard measuring the amount of THC emissions over a non-hazardous fuel baseline combined with backup risk assessment. No mention is made of a dual CO/THC baseline in any of the comments, and at oral argument counsel for the EPA conceded that this indicated that no notice was provided of a possible CO baseline standard for wet kilns. In sum, the EPA cannot base notice of the Tier III standard on either submitted comments or proposals concerning individual parts of the ultimate standard. The Tier III standard not being a logical outgrowth of any precursor proposal, it is vacated and remanded for further consideration.

3. *Are the EPA's Rules to Control PIC Emissions Reasonable?*

As discussed above, the EPA enacted a three-tiered protective standard to control emissions from the burning of hazardous fuels. The cement kiln petitioners attack the rationale underlying these standards, contending that each is arbitrary and capricious. Under our familiar rubric, "[t]he scope of judicial review of agency decisionmaking under the arbitrary-and-capricious standard is narrow. Nonetheless, the agency must examine the relevant data and articulate a satisfactory explanation for its action including a rational connection between the facts found and the choice made." *Natural Resources Defense Council v. EPA,* 859 F.2d 156, 209 (D.C. Cir. 1988) (footnote and internal quotation marks omitted).

a. *The Tier III Standard*

These petitioners contend that the Tier III standard has no rational basis. First, they argue that the EPA articulated no basis for its conclusion that kilns could reliably quantify both CO and THC baselines when burning non-hazardous fuel. In the BIF Rule, the EPA adduced two pieces of support: "commenters[']  [assertions] that when

hazardous waste is burned, hydrocarbon levels do not increase and often decrease," 56 Fed. Reg. 7,157, col. 1, and the results of test runs on a single wet process cement kiln located at Hannibal, Missouri. 56 Fed. Reg. 7,157 col. 1, 7,163 col. 2. The results of the test runs allegedly demonstrated that emissions of THC are quantifiable and actually decrease when hazardous fuels are burned (in comparison to a non-hazardous waste burning baseline). *Id.; Emissions Testing of a Wet Cement Kiln at Hannibal, Missouri,* BBSP-SO147, *reprinted in* J.A. at 218, Table 4-13 at 4-22. Yet Table 4-13 reveals the very problem raised by the cement kiln petitioners: that the inhomogeneity of the organic material in the raw materials precludes the establishment of a reliable baseline, and thus the baselines are not a valid indicator of good combustion. At oral argument, moreover, counsel for the EPA disavowed reliance on the Hannibal test runs, admitting that they were conducted for a different purpose and could not be relied on to support the Tier III standard.

Thus the supportive comments cited by the EPA are the sole evidence of the feasibility of the Tier III standard. These comments, however, refer only to the possibility of implementing a THC baseline and make no reference to the possibility of simultaneously quantifying CO and THC baselines. The agency thus had no information on this issue and was relying on pure speculation when it decided that a standard of no increase of CO and THC over quantifiable CO and THC baselines was achievable. *See National Gypsum Co. v. EPA,* 968 F.2d 40, 43-44 (D.C. Cir. 1992) (agency cannot "infer" facts not in the record); *Natural Resources Defense Council,* 859 F.2d at 210 (agency actions based upon speculation are arbitrary and capricious). Such speculation is an inadequate replacement for the agency's duty to undertake an examination of the relevant data and reasoned analysis; thus the EPA's action in promulgating the Tier III standard was arbitrary and capricious. *See Specialty Equip. Mid. Ass'n v. Ruckelshaus,* 720 F.2d 124, 137 (D.C. Cir.

1983) (agency's lack of justification demonstrates action was arbitrary and capricious).

We note that, at oral argument, counsel for the cement kiln petitioners maintained that they had proposed three alternative methods by which the objectives of the Tier III standards could be met and that the EPA had failed to consider those comments. The EPA, of course, is obliged to respond to "relevant" and "significant" comments. *Home Box Office, Inc. v. FCC*, 567 F.2d 9, 35 & n.58 (D.C. Cir. 1977). We need not consider this argument as grounds for remand, however, because the cement kiln petitioners failed to raise it prior to oral argument; thus we deem it waived.

b. *Tier I and Tier II Standards*

All BIFs are governed by the three-tiered standard; thus, even though we have vacated the Tier III standard, wet process kilns remain subject to the first two. The cement kiln petitioners do not contend that they were provided with inadequate notice or opportunity for comment on the Tier I and Tier II standards, but they do argue that these standard are "fundamentally irrational" as applied to wet kilns and must be vacated as arbitrary and capricious.

The EPA argues that the three tiers implement its statutory duty, and that if wet kilns cannot comply with one of these standards, they should simply stop burning hazardous wastes as fuel. The EPA attests, and the cement kiln petitioners do not dispute, that there are dangers, known and unknown, associated with burning hazardous wastes. Ultimately, it is PIC emissions that are being regulated, and from the standpoint of health and safety, there is no reason to distinguish between PICs emitted from the combustion of hazardous wastes and those emitted from the combustion of the slurry. The EPA has determined that

> hazardous waste burning may affect the type and concentration of organic compounds emitted from an industrial furnace that has elevated HC concentrations attributable to raw materials. For example, the chlorine in the hazardous waste may result in higher concentrations of chlorinated organic compounds.

56 Fed. Reg. 7,157, col. 3. The EPA candidly admits that the use of CO and THC as indicators of combustion efficiency is problematic as applied to wet kilns, yet it contends that the existing PIC standards are the best application of existing scientific knowledge. "This court does not demand certainty when there is none[,] and the Agency here may apply its expertise to draw conclusions from . . . probative preliminary data not yet certifiable as fact and the like." *Solite Corp. v. EPA*, 952 F.2d 473, 490 (D.C. Cir. 1991) (internal quotation marks and citation omitted). As we have stated before, "[w]e cannot of course substitute our judgment for that of the agency. What we do require is that the [agency] come to grips with the obvious ramifications of its approach and address them in a reasoned fashion." *Natural Resources Defense Council*, 859 F.2d at 209-10 (internal quotation marks and footnotes omitted).

In the instant case, the EPA has met this standard—it recognized the effects that the Tier I and Tier II standards would have on wet kilns and attempted to accommodate them in the Tier III standard. The lack of notice and a reasoned basis for the Tier III standard necessitates that it be vacated, but the inapplicability of the other two to wet kilns, standing alone, does not persuade us that their promulgation was arbitrary and capricious. The EPA issued those regulations as protective of human health and the environment; and if it is technologically impossible for wet process kilns to meet them, they can simply stop using hazardous waste as fuel. *See id.* at 206-09 (EPA has no duty to provide for variances from

water quality standards that may be technologically impossible to achieve).

We thus vacate and remand the Tier III standard while affirming the Tier I and Tier II standards. Nonetheless, we note that the EPA has recognized that the Tier I and Tier II standards are inappropriate for wet process cement kilns. The agency may therefore wish to consider establishing an interim replacement standard for Tier III under the "good cause" exemption of 5 U.S.C. § 553(b)(3)(B) pending full notice and opportunity for comment. *See, e.g., Shell Oil*, 950 F.2d at 752.

## III. Conclusion

For the reasons given above, the BIF Rule is upheld in part, and the Tier III PIC standard is remanded to the EPA for reconsideration consistent with the terms of this opinion.

*So Ordered.*

## APPENDIX B

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 261, 264, 265, and 266

[EPA/OSW-FR-92-SWH-FRL-4198-5]

Burning of Hazardous Waste in Boilers and Industrial Furnaces

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule; technical clarification amendments and corrections.

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SUMMARY: This action makes several technical clarification amendments and corrections to the final rule for boilers and industrial furnaces burning hazardous waste. The final rule was published on February 21, 1991 (56 FR 7134). These revisions provide clarification and correct unintended consequences of the rule.

EFFECTIVE DATE: August 11, 1992.

ADDRESSES: The documents are available for viewing at the RCRA Information Center (docket identification number F-92-BBC3-FFFFF), located at: EPA/RCRA Information Center, room M2427, 401 M Street, SW, Washington, DC 20460.

The RCRA Information Center is open from 9 a.m. to 4 p.m. Monday through Friday, except for federal holidays. The public must make an appointment to review docket materials. Call (202) 260-9327 for appointments. Copies cost $0.15 per page.

FOR FURTHER INFORMATION CONTACT: For general information, contact the RCRA Hotline at: (800) 424-9346 (toll free) or (703) 920-9810.

Shiva Garg, Office of Solid Waste (OS-322W), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, (703) 308-8459.

SUPPLEMENTARY INFORMATION:

Preamble Outline

A. Technical Clarification Amendments

1. The Definition of Baseline Hydrocarbon Level for Industrial Furnaces Complying with the Alternative Hydrocarbon Limits is Clarified to Require Consideration of Process Variability.

2. Industrial Furnaces Complying with the Alternative HC Limit May Comply with the Interim HC Limit Using a Conditioned Gas HC Monitoring System if They Demonstrate that a Heated System Is Impracticale.

3. Industrial Furnaces that Cannot Comply with the 20 ppmv HC Limit by Aug. 21, 1992, because of Organic Matter in Raw Materials May Apply for a Case-by-Case Time Extension to Make Physical Changes to the Facility in Order to Comply with that HC Limit.

4. The Metals and Total Chlorine and Chloride Feed Rate Operating Limits for Tier I or Adjusted Tier I Are Based on the Screening Limits, Not the Compliance Test.

5. Adjusted Tier I Feed Rate Screening Limits May Be Used in Dispersion Situations where the Tier I and Tier II Screening Limits Are Precluded.

6. Several Requirements Are Clarified to Account for Facilities that Comply with Adjusted Tier I Limits.

7. BIF Storage Units are Subject to the Air Emissions Standards of subparts AA and BB of parts 264 and 265.

8. The Definitions of Plasma Arc and Infrared Incinerators Are Clarified to Include Only those Devices that Use an Afterburner.

9. Facilities that Comply with the Tier I or Adjusted Tier I Metals and Chlorine Controls and that have Uncontrolled Emissions that Meet the Particulate Matter Standard Need Not Establish a Limit on Production Rate during Interim Status.

10. Halogen Acid Furnaces that Burn Hazardous Waste as an Ingredient Are Subject to the BIF Rule.

11. When Comparing Levels of Nonmetal Constituents in Residue to the Health-Based Limits for the Bevill Exclusion, the Levels Cannot Exceed the Health-Based Limits or the Level of Detection, whichever Is Higher.

12. The Applicability of part 266 Is Clarified.

13. Conforming Revisions Are Made to the Applicability Sections of parts 264 and 265.

14. A Conforming Revision Is Made to the Rulemaking Petitions Provision of part 260.

B. Technical Corrections

C. Immediate Effective Date

A. Technical Clarification Amendments

On February 21, 1991, the Agency published a final rule which regulates the burning of hazardous waste in boilers and industrial furnaces (BIFs). See 56 FR 7134. The rule controls emissions of toxic organic compounds, toxic metals, hydrogen chloride, chlorine gas, and particulate matter from BFIs that burn hazardous waste. In addition, the rules subject owners and operators of BIFs to the general facility and permitting standards applicable to hazardous waste treatment, storage, and disposal facilities.

After publication of the rule, the Agency received many questions and requests for clarification on certain provisions of the rule. In addition, in a number of cases, the Agency was questioned as to whether the rule as promul-

gated truly reflected the Agency's intent. As a result of these questions and as a result of the Agency's own review, the Agency published a technical amendment to the rule to clarify the operation of the regulation and to correct certain unintended consequences. Those amendments were published at 56 FR 42504 on August 27, 1991. (Note that EPA had previously published several other technical corrections and amendments to the February 21 final rule (56 FR 32688 (July 17, 1991).)

As facilities began to comply with the BIF rules, additional questions have been raised about the way various provisions of the rule are intended to work. Today's technical clarification amendments address those questions.

*1. The Definition of Baseline Hydrocarbon Level for Industrial Furnaces Complying With the Alternative Hydrocarbon Limit Is Clarified To Require Consideration of Process Variability*

The Cement Kiln Recycling Coalition (CKRC) has expressed concern to the Agency that the alternative hydrocarbon (HC) provision of the rule is problematic for furnaces that feed raw materials containing naturally-occurring organic matter.[1] See § 266.104(f). That provision was intended to allow furnaces that could not comply with the 20 ppmv HC limit because of organic matter in raw materials to comply with an alternative, higher HC limit. EPA's rationale for the 20 ppmb limit was to ensure good hazardous waste combustion conditions and, thus, control of emissions of products of incomplete combustion (PICs). However, because hydrocarbon emissions from organic matter in raw materials are not directly related to fuel-generated hydrocarbons (i.e., from burning normal fuels and hazardous waste fuels), the

[1] See the BIF docket for documentation of meetings and phone conversations and copies of correspondence.

Agency believed that these hydrocarbon should not be counted toward the 20 ppmv HC limit. See 56 FR 7155-56. To implement the alternative HC limit, the final rule required such furnaces to establish an HC limit that would be applicable when burning hazardous waste as the HC level achieved when not burning hazardous waste and when the furnace is operated to "minimize" HC levels. See § 266.104(f)(1).

CKRC has noted that this provision could be read to limit fuel-generated hydrocarbons to approximately 2 to 5 ppmv—the HC levels that are achieved when cement kilns (and boilers, incinerators, and other industrial furnaces) are operated under conditions to absolutely minimize HC levels. Therefore, although the Agency limits combustion-generated hydrocarbons from other combustion devices to 20 ppmv, the rule could be read to limit fuel-related hydrocarbon levels from cement kilns to 2 to 5 ppmv. In particular, CKRC notes that the rule could be interpreted to limit hydrocarbons when burning hazardous waste to the levels achieved when not burning hazardous waste (i.e., baseline conditions) and when kiln is operated to absolutely minimize HC levels and would not allow the facility to account for normal transient combustion conditions that occur because of factors such as mechanically handling coal. These conditions are elements of normal operating variability. Although these transient conditions cause combustion perturbations and momentary increases (i.e., spikes) in HC levels, these combustion-related HC levels do not generally exceed the 20 ppmv hourly rolling average limit that the Agency has established to control PICs.

Nonetheless, the most literal-minded reading of the rule would preclude consideration of these normal combustion perturbations if the rule's requirement that baseline HC levels be established when the kiln is operated to minimize HC levels is read to mean to operate constantly at

absolute peak performance.[2] This literal-minded reading would lead to the result—not intended by EPA—that whenever such a normal combustion perturbation would occur (when the kiln is burning hazardous waste) and there is a spike in the HC level that causes the baseline HC level to be exceeded, the kiln would be required to stop burning hazardous waste and not restart the hazardous waste feed until the HC level falls below the baseline limit. Nor did EPA intend that industrial furnaces operate at an absolutely optimized performance in establishing a baseline ignoring normal operating variability (i.e., a performance level analogous to a New Source Performance Standard rather than best available technology). Indeed, the rule refers to establishing a baseline when the industrial furnace "produces normal products under normal operating conditions" (see § 266.104(f)(1)), and the analogous 20 ppmv HC limit itself is an "indicator of good combustion conditions" (see 55 FR 7155), not absolutely optimized combustion.

Although EPA believes these readings take an unduly stringent view of the requirement that HC levels be minimized when establishing a baseline, we nevertheless think it best to clarify the text of the rule. Therefore, EPA is correcting the definition of the baseline HC level provided by § 266.104(f)(1) to make it clear that the measured baseline HC level must be adjusted as appropriate to consider the normal variability of hydrocarbon levels

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[2] Even if the rule were interpreted to allow normal combustion perturbations (i.e., perturbations that do not result in combustion generated hydrocarbons exceeding 20 ppmv on an hourly rolling average, and thus, are within the Agency's definition of good combustion conditions) during baseline testing, establishing a baseline that includes such normal perturbations would be problematic. This is because the owner or operator cannot ensure that the perturbations that occur during the baseline testing are representative (i.e., in frequency, magnitude, and duration) of normal perturbations. The occurrence of normal perturbations cannot always be predicted, and it would be difficult for the owner or operator to demonstrate that perturbations that could be artificially induced during baseline testing are representative of normal perturbations.

under good combustion operating conditions. Thus, the measured baseline level could be increased by a variability factor that considers normal transient combustion conditions (i.e., provided that the transient conditions do not result in combustion-generated HC that exceed the 20 ppmv limit provided by § 266.104(c)). Accordingly, today's clarification amends the definition of the baseline HC level in § 266.104(f)(1) to read as follows: "The baseline HC level is defined as the average over all valid test runs of the highest hourly rolling average value for each run, adjusted as appropriate to consider the variability of hydrocarbon levels under good combustion operating conditions."

This HC variability factor would be determined on a case-by-case basis by the Director. As guidance in determining what variability factor to apply, EPA believes that a factor of 10 ppmv would be appropriate in most situations.[3] As indicated previously, the Agency believes that combustion-generated HC levels from cement kilns (and other furnaces eligible for the alternative HC limit) should be limited to 20 ppmv to ensure good combustion conditions. This is the same HC limit that applies to boilers, other furnaces, and incinerators, and provides a "level playing field" with respect to control of combustion-generated hydrocarbons. Thus, we recommend that the alternative HC limit be established as 20 ppmv plus the raw material-generated HC level. We do not believe that it is feasible, however, to measure only raw material-generated hydrocarbons; the HC monitor in the stack measures both hazardous waste combustion-generated and

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[3] We note that, if a variability of 10 ppmv is used to adjust he measured baseline HC level, facilities with measured HC levels of 11 ppmv or greater would be eligible for the alternative HC limit. This is because the baseline HC level, when adjusted for the 10 ppmv variability factor, would be 21 ppmv or more and facilities with baseline HC levels exceeding 20 ppmv are eligible for the alternative HC limit.

raw material-generated hydrocarbons. Therefore, to estimate the level of raw material-generated hydrocarbons, it is conservative and reasonable to assume that 10 ppmv [4] of the HC measured under baseline conditions (when the kiln must be operated to minimize combustion-generated hydrocarbons) is attributable to hazardous waste combustion. (Note that when the kiln is operated to absolutely minimize hazardous waste combustion-generated hydrocarbons, HC levels should be in the range of 2 to 5 ppmv. Thus, the recommended assumption that combustion-generated hydrocarbons are 10 ppmv during baseline testing is conservative.[5] Under this approach, raw material-generated hydrocarbons are estimated to be the measured HC level during baseline testing minus 10 ppmv. The 20 ppmv combustion-generated HC allowance would then be added to the estimated raw material-generated hydrocarbons. The net effect would be simply to add 10 ppmv to the measured baseline HC level.

As discussed above, the rational for adding a variability factor to the measured baseline HC level assumes that the baseline level is determined when the device is operated under conditions that generally minimize combustion-generated hydrocarbon.[6] Therefore, combustion-generated

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[4] Note that the assumption that 10 ppmv of HC during baseline testing is attributable to hazardous waste combustion is not the basis for the recommended 10 ppmv variability factor. As discussed in the text, however, this assumption leads to the Agency's conclusion that a 10 ppmv variability factor is appropriate.

[5] The assumption that combustion-generated HC is 10 ppmv during baseline testing is conservative because if, for example, we assumed that combustion-generated HC is 5 ppmv, the variability factor would be 15 ppmv, not 10 ppmv. This is because, the lower that the combustion-generated HC is assumed to be, the higher the raw material-generated HC is estimated to be, and the 20 ppmv allowance for combustion-generated HC is added to the estimated raw material-generated HC.

[6] Although it is not practicable for an industrial furnace to operate continuously under conditions that minimize combustion-generated HC as discussed previously in the text, it is reasonable

hydrocarbon spikes causing a significant increase in the hourly rolling average HC level should not be allowed during baseline testing. To ensure that substantial variability is not already included in the baseline HC level, the hourly rolling average hydrocarbon level should not vary during baseline testing by more than 5 ppmv when measured HC levels are in the range of 10-30 ppmv. When measured HC levels exceed 30 ppmv, then a higher allowable range of HC levels (i.e., the difference between the highest and lowest hourly rolling average level) during baseline testing may be appropriate given that the absolute HC levels are higher and even minor perturbations could cause significant changes in HC levels.[7]

EPA is interested in obtaining further information on whether this recommended approach is reasonable to establish an alternative HC limit for devices that cannot meet the 20 ppmv HC limit because of organic matter in raw materials. EPA therefore invites all interested persons to submit any relevant information on this issue.

2. *Industrial Furnaces Complying With the Alternative HC Limit May Comply With the Interim HC Limit Using a Conditioned Gas HC Monitoring System if They Demonstrate That a Heated System Is Impracticable*

Section 266.103(c)(5) of the rule allows owners and operators of BIFs, other than those that obtain a time extension, to certify compliance with the 20 ppmv HC limit using a conditioned gas (i.e., cold) HC monitoring system rather than a heated monitoring system. Although

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and necessary to require the facility to operate during baseline testing under conditions that generally minimize combustion-generated HC. This is because, otherwise, a variability factor would be added to a baseline HC level that may already include substantial variability.

[7] Baseline testing should consist of a minimum of three test runs, with each run having a minimum duration of three hours.

the Agency prefers the heated system because a cold system may remove some hydrocarbons during gas conditioning (e.g., chilling the gas sample line to condense water vapor can also remove hydrocarbons), the Agency recognized that heated systems are not in widespread use on BIFs and modifications to the monitoring systems may be necessary to address operation and maintenance problems. See 56 FR 7162 (February, 21, 1991). Consequently, the Agency reasoned that facilities that comply with the HC limit on Aug. 21, 1992, should be allowed to use a cold system. On the other hand, he Agency reasoned that those owners and operators who obtain a time extension should be required to certify compliance with a hot system given that the time extension should provide enough time to resolve operation and maintenance problems. (Note that facilities that elect to certify compliance with a cold system on Aug. 21, 1992, must use a hot system when they recertify compliance under interim status or obtain a RCRA operating permit. See § 266.103 (c)(5).

The Agency did not anticipated the consequences that this requirement would have on cement kilns complying with the alternative hydrocarbon provision of §§ 266.104 (f) and 266.103(c)(7)(ii)(B). Under thoes requirements, cement kilns must, prior to August 21, 1992, submit a complete Part B permit application that includes documentation of the baseline HC level, and obtain a time extension from the Director. Until the operating permit is issued, the facility must comply with an interim HC (and CO) limit effective no later than August 21, 1992, that is established as a condition of the time extension.

Consequently, although cement kilns complying with the alternative hydrocarbon provision must obtain a time extension, they must monitor hydrocarbons prior to August 21, 1992, in order to establish the baseline HC level, and must monitor hydrocarbons continuously beginning

August 21, 1992. Thus, § 266.103(c)(5) has the unintended consequence of requiring such facilities to use a hot HC monitoring system on (and before) August 21, 1992.

As discussed above, the Agency has already determined that this is infeasible (and therefore provided a conditioned (i.e., cold) monitoring option). Therefore, to give such facilities the time they may need to resolve operating and maintenance problems with hot monitoring systems, today's technical correction revises § 266.103(c)(5) to enable the Director to approve on a case-by-case basis the use of a cold system for establishing the baseline HC level and complying with the alternative, interim HC limit. This correction is a logical and necessary adjunct to the existing regulation that allows the alternative use of cold HC monitoring systems. The Director's approval will be based on a demonstration by the facility that it has made a good faith effort to install and operate a heated system but that it has determined that continuous operation is not practicable at this time. The Agency does not believe that this demonstration will be a burden on owners and operators because they have known since February 21, 1991, that a hot monitoring system was required by the rule and should have been attempting to operate continuously such systems for some time.

In considering a request to use a conditioned gas monitor in lieu of a hot monitor, the Director may impose additional requirements on the owner and operator of the facility to ensure that a hot monitoring system is installed as soon as practicable. See § 266.103(c)(7)(ii)(A). For example, the Director may require the owner or operator to operate a hot monitoring system to the extent practicable concurrently with a conditioned gas monitoring system in order to meet specified milestones in activities designed to resolve operational problems with a heated HC monitoring system, and to report periodically on

progress toward achieving sustained operation of the hot monitoring system.

This amendment does not extend the deadline for certification of compliance. Owners and operators requesting to comply with the alternative hydrocarbon limit are required to submit their request along with accompanying supporting materials in time to allow the Director to grant or deny the request by August 21, 1992.

*3. Industrial Furnaces That Cannot Comply With the 20 PPMY HC Limit by August 21, 1992, Because of Organic Matter in Raw Materials May Apply for a Case-by-Case Time Extension To Make Physical Changes to the Facility in Order to Comply With That HC Limit*

The Agency is clarifying the rule to make it clear that industrial furnaces that cannot comply with the 20 ppmv HC limit for reasons beyond the owner's or operator's control may request a time extension to certify compliance with the HC limit. The final rule allows facilities that elected to comply with the alternative hydrocarbon provisions of § 266.104(f) to obtain a time extension under § 266.103(c)(7)(ii)(B). However, the Agency inadvertently did not make it clear that owners and operators that elected to make physical changes to the facility to enable them to comply with the 20 ppmv HC limit (i.e., the usual HC limit, rather than an alternative limit established on a case-by-case basis) but who cannot do so by August 21, 1992, for reasons beyond their control are also eligible to request a time extension under § 266.103 (c)(7)(ii).

EPA meant for § 266.103(c)(7)(ii)(B) to apply only to facilities that comply with the alternative HC limit, and believes that this intent is fairly clear in the existing regulatory language since the provision (§ 266.103(c)(7)(ii)(B)(2)) references the procedure for establishing CO

and HC baseline levels (§ 266.104(f)(1)) applicable only to persons complying with the alternative HC limit. Conversely, the provisions make little sense for persons who intend to comply with the limit of 20 ppmv because the requirements in § 266.103(c)(7)(ii)(B) are related only to the alternative HC limit.

Accordingly, today's amendment revises § 266.103(c)(7)(ii)(B) to clarify that paragraph applies only to facilities that comply with the alternative HC limit. Thus, the general time extension provision of § 266.103(c)(7)(ii) applies to all other situations, including industrial furnaces that need time to modify the facility to comply with the 20 ppmv HC limit.

Industrial furnaces such as cement kilns may elect to make physical modifications to the facility to enable them to certify compliance with the 20 ppmv HC limit rather than to comply with the alternative HC provisions of § 266.104(f). If those modifications cannot be completed in time to enable the facility to certify compliance by August 21, 1992, for reasons beyond the facility's control, the owner or operator may request a time extension.

If a time extension is granted, the Director will use the authority of § 266.103(c)(7)(ii) to establish operating conditions as necessary to reasonably ensure that emissions of toxic organic compounds do not pose a threat to human health and the environment. Operating conditions that may be applied may include limits on the type, quantity, and method of firing hazardous waste, and limits on combustion parameters such as oxygen, carbon monoxide, and hydrocarbons.

Examples of physical changes that may be made to the facility in order to meet the 20 ppmv HC limit are: (1) Installation of a secondary combustion chamber to destroy organic compounds in the kiln off-gas; or (2) installation of a roaster to volatilize organic compounds from the raw material before feeding it to the kiln where hazardous

waste is burned. These changes may enable the owner or operator to demonstrate that stack gas concentrations do not exceed the 20 ppmv limit. At this time, the Agency has not evaluated the practicability of installing a secondary combustion chamber or roaster to reduce HC emissions. The Agency is simply identifying these as conceivable changes that may enable a facility to meet the 20 ppmv HC limit.

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## APPENDIX C

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 261, 264, 265, 266, 270 and 271

[EPA/OSW-FR-91-012; SWH-FRL-3865-6]

RIN 2050-AA72

Burning of Hazardous Waste in Boilers and Industrial Furnaces

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: Under this final rule, the Environmental Protection Agency (EPA) is expanding controls on hazardous waste combustion to regulate air emissions from the burning of hazardous waste in boilers and industrial furnaces. Currently, such burning is exempt from regulation. EPA is promulgating this final rule after considering public comment on rules proposed on May 6, 1987, plus the comments on EPA's supplemental notices of October 26, 1989 and April 27, 1990.

These rules control emissions of toxic organic compounds, toxic metals, hydrogen chloride, chlorine gas, and particulate matter from boilers and industrial furnaces burning hazardous waste. In addition the rules subject owners and operators of these devices to the general facility standards applicable to hazardous waste treatment, storage, and disposal facilities. Further, today's final rule subjects hazardous waste storage units at regulated burner facilities to part 264 permit standards. Burner storage operations at existing facilities are generally now subject only to interim status standards under part 265.

Finally, today's rule takes final action on two pending petitions for rulemaking: (1) based on a petition by Dow Chemical Company, EPA is designating halogen acid

furnaces as industrial furnaces under § 260.10; and (2) based on a petition by the American Iron and Steel Institute, EPA is classifying coke and coal tar fuels produced by recycling coal tar decanter sludge, EPA Hazardous Waste No. KO87, as products rather than solid waste. The rule also makes several technical corrections to regulations dealing with loss of interim status for facilities that achieved interim status as of November 7, 1984.

EFFECTIVE DATE: This final rule is effective on August 21, 1991. Technical corrections to § 270.73 are effective on publication.

The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of August 21, 1991.

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II. Controls for Emissions of Toxic Organic Compounds

Burning hazardous waste that contains toxic organic compounds (i.e., organic compounds listed in appendix VIII of 40 CFR part 261) under poor combustion conditions can result in substantial emissions of the toxic compounds originally present in the waste as well as other compounds, due to partial but incomplete combustion of the constituents in the waste. The quantity of toxic organic compounds emitted depends on the concentrations of the toxic compounds in the waste, the waste firing rate (i.e., the percentage of total fuel provided by the hazardous waste to the boiler or industrial furnace), and the combustion conditions under which the waste is burned. The risk posed by the emissions depends on the quantity and toxicity of the compounds emitted and on the ambient levels to which persons are exposed. Hypothetical risk assessments show that under poor combustion conditions that achieve only 99 percent or 99.9 percent destruction and removal efficiency (DRE) of organic compounds, risks to the maximum exposed individual (MEI) from

unburned carcinogenic organics found in hazardous waste can result in increased lifetime cancer risks of 10.[9, 10]

The Agency is controlling the emissions of toxic organic compounds from boilers and industrial furnaces that burn hazardous waste with two performance standards. First, a 99.99 percent destruction and removal efficiency (DRE) standard for principal organic hazardous constituents (POHCs) in waste feeds will ensure that constituents in the waste are not emitted at levels that could pose a significant risk in virtually all scenarios of which the Agency is aware.[11] Second, limits on flue gas concentration of carbon monoxide (CO) and, where specified, hydrocarbons (HC) will ensure that combustion devices operate continuously at high combustion efficiency and emit products of incomplete combustion (PICs) at levels that will not pose adverse effects on public health and the environment. The basis for these standards is discussed below.

*A. DRE Standard*

As proposed, the Agency is promulgating a 99.9999% DRE standard [12] for those acutely hazardous wastes listed

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[9] We note, moreover, that some boilers and many industrial furnaces are already subject to a particulate matter (PM) standard under a NSPS, SIP, or PSD program and the applicable PM standard is generally more stringent than the 0.08gr/dscf standard provided by today's rules. Thus, these devices are already under a regulatory compliance program for a PM standard. We note further that the more stringent PM standard applies.

[10] Engineering-Science, Background Information Document for the Development of Regulations to Control the Burning of Hazardous Waste in Boilers and Industrial Furnaces, Volume III, January 1987 (NTIS # PB 87 173845).

[11] Except that 99.9999% DRB is required for dioxin-listed hazardous waste.

[12] The proposed formula for calculating DRE has been revised in the final rule (see § 266.104(a)), to make it mathematically correct considering use of significant figures.

because they contain dioxin [13] (and waste mixed with those wastes), and a 99.99 percent DRE performance standard for all other wastes. This standard is protective, it can be readily achieved by boilers and industrial furnaces, and it will ensure that the Agency's controls are consistent for all combustion devices (boilers, industrial furnaces, and incinerators) that pose similar risks.

Hypothetical risk assessments have shown that a 99.99 percent DRE standard for POHCs is protective of risks posed by emissions of organic constituents in the waste in virtually every scenario of which the Agency is aware.[14] (EPA considers elsewhere in this notice the issue of products of incomplete combustion.) Increased lifetime cancer risks to the maximum exposed individual (MEI) from an incinerator operating at 99.99 percent DRE would generally be $10^{-6}$ or less. Threshold (i.e., noncarcinogenic) organic compounds also would not be expected to be present in emissions from hazardous waste burned in boilers and industrial furnaces at levels that could pose a health hazard under the 99.99 percent DRE standard.

EPA, is aware, however, that the DRE standard does not directly control the mass emission rate (e.g., pounds per hour) of unburned toxic organic constituents in the waste. Although three are hypothetical situations in which risks from POHCs could be significant under a 99.99 percent DRE standard (e.g., boilers or industrial furnaces located in urban areas burning high volumes of waste with high concentrations of highly potent carcinogenic organics) the Agency is not aware that any such situations are actually occurring. If, however, during the permit process, it appears that a high-risk scenario may exist,

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[13] EPA Hazardous Wastes FO20, FO21, FO22, FO23, FO26, and FO27.

[14] Engineering Science, op. cit.

permit officials may use the omnibus permit authority [15] of section 3005(c)(3) of the Resource Conservation and Recovery Act (RCRA) codified at § 27O.32(b)(2) to develop permit requirements, as necessary, to protect human health and the environment (e.g., by requiring a 99.9999 percent DRE, by limiting the feed rate of particular toxic compounds, or by setting a mass emissions rate).

1. Selection of POHCs for DRE Testing

In the April 27, 1990 proposed rule to amend the incinerator standards (55 FR 17890), EPA outlined the considerations to be made by applicants and permitting officials in selecting POHCs for DRE trial burns. Given that the DRE implementation procedures for boilers and industrial furnaces (BIFs) are identical to those for incinerators, the discussions in the incinerator proposed rule are pertinent to this rule.

A major factor in selecting a POHC for DRE testing is its incinerability relative to other toxic organic compounds. A number of indices can be used to predict incinerability including heat of combustion, autoignition temperature, thermal stability under excess oxygen conditions, and thermal stability under low oxygen (substoichiometric) conditions. An incinerability ranking based on thermal stability at low oxygen concentrations ($TSLoO_2$) shows promise and is currently seeing widespread use in incinerator permits. A number of commenters responded to EPA's request for comment on the use of the $TSLoO_2$

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[15] EPA notes that permit writers choosing to invoke the omnibus permit authority of § 270.32(b)(2) to add conditions to a RCRA permit must show that such conditions are necessary to ensure protection of human health and the environment and must provide support for the conditions to interested parties and accept and respond to comment. In addition, permit writers must justify in the administrative record supporting the permit any decisions based on omnibus authority.

index for POHC selection. In general, they raised no problems with use of the index. Their main concern appeared to be that EPA choose one index and apply it consistently.

The Agency, however, is not requiring the use of a particular index. Due to the various "failure modes" different organic compounds are susceptible to during the destruction process in a combustion device, and the evolving state of knowledge in this area, the Agency feels that the POHC selection process is technically complex, and that it should involve a number of considerations, rather than simply one incinerability ranking. Thus, EPA instead recommends that permit writers and applicants consider these indices and other relevant factors and use their judgment and applicable guidance on a case-by-case basis to select POHCs for the trial burn.

2. Use of POHC Surrogates

A number of laboratory-scale, pilot-scale, and field-scale tests have been conducted to investigate the use of nontoxic tracer surrogates (e.g., sulfur hexafluoride ($SF_6$)) rather than POHCs selected from appendix VIII of part 261. Sulfur hexafluoride, in particular, shows promise as a conservative tracer surrogate for compounds which are susceptible to the thermal failure mode (i.e., it is difficult to destroy unless sufficiently high temperatures are reached). It is readily available commercially, and is inexpensive and nontoxic. POHCs that are listed on appendix VIII, especially in situations where spiking is required to increase concentrations in a waste for DRE testing, are often difficult to obtain, are expensive, and are a health hazard to operators. Sampling and analysis techniques for $SF_6$ are well documented because of its long use as a tracer gas for monitoring ambient air and are more straightforward (simpler) and less expensive than sampling techniques for appendix VIII, part 261, compounds (e.g., VOST and MM5).

Numerous commenters responded to EPA's request for information on an approach for simplifying and standardizing DRE testing. Commenters supported standardization of DRE testing provided the approach is equitable for all boilers, industrial furnaces, and incinerators. Comments were received in support of all three approaches proposed by EPA ("POHC soup," surrogates, and specific waste analysis). Commenters generally supported use of surrogates in lieu of extensive waste analysis for design of DRE tests. Other commenters suggested using a limited number of major waste constituents as POHCs, such as carbon tetrachloride, perchloroethylene, trichloroethylene, and monochlorobenzene, until it can be shown that a universal surrogate, such as sulfur hexafluoride ($SF_6$), is comparable in demonstrating DRE performance. Sulfur hexafluoride was recommended by some commenters as a good surrogate choice based on the high accuracy of results with the compound and ease of use.

However, since the April 27 proposed rule, data have become available showing cases where other organic compounds were more difficult to destroy than $SF_6$ under conditions of low oxygen. This is consistent with theory, since $SF_6$ can be destroyed under conditions of high temperature and low oxygen relatively easily compared to compounds which need oxygen to decompose. Thus, although $SF_6$ appears to show promise as a surrogate for testing the thermal failure mode because of its stability at high temperatures, it does not appear to be adequate as a "universal" surrogate, since it does not test for low oxygen or "mixing" failure.

Nevertheless, today's rule explicitly allows the use of surrogate, nontoxic compounds for selection as POHCs for DRE testing. As for any other type of POHC, the use of such compounds must be approved on a case-by-case basis by permit officials based on technical support provided by the applicant. The applicant's trial burn plan must adequately document the correlation between

the DRE of the surrogate compound and the DREs of the appendix VIII compounds anticipated to be burned at the facility under the facility's permit.

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*B. PIC Controls*

The burning of hazardous waste, like virtually any combustion process, results in emissions of incompletely burned organic compounds, or products of incomplete combustion (PICs). PICs can be unburned organic compounds that were present in the waste, thermal decomposition products resulting from organic constituents in the waste, or compounds synthesized during or immediately after combustion. If a device is operated under poor combustion conditions, substantial emissions of PICs can result (even if 99.99% DRE is demonstrated for POHCs; this just means that the POHC is not being emitted in its original form). However, it should be noted that estimates of risk to public health resulting from PICs, based on available emissions data, indicate that PIC emissions do not pose significant risks when BIFs and incinerators are operated under good combustion conditions.

Nonetheless, the Agency is concerned about the potential health risk from PICs because the available information has serious limitations. It is very difficult to identify and quantify emissions of thousands of different compounds, some of which are present in minute quantities. Although elaborate and expensive sampling and analytical techniques have been developed that can identify many PICs, many others cannot be identified and quantified with current techniques. Further, health effects information adequate to conduct a health risk assessment considering exposure via direct inhalation is not currently available on many organic compounds that may be emitted from combustion systems. Finally, the available public health and environmental risk assessment tools are incomplete. Data are currently available to conduct indirect

exposure analyses (e.g., exposure via the food chain, drinking water, dermal exposure) on only a few organic compounds, and it will be some time before the Agency will be able to quantify impacts on ecological resources on a site-specific basis for purposes of establishing emissions standards.

Given the limited information about the hazards that PIC emissions may pose, EPA believes it is prudent to require that boilers and industrial furnaces operate at a high combustion efficiency to minimize PIC emissions.

EPA is promulgating today a two-tiered approach to control PICs as discussed in the October 29, 1989, supplemental notice (54 FR 43721-28). Under Tier I, CO is limited to 100 ppmv. Under Tier II, the Agency is providing an alternative standard. The facility need not meet the 100 ppmv CO limit provided the facility can demonstrate that the hydrocarbon (HC) concentration in the stack gas does not exceed a good operating practice-based limit of 20 ppmv. The alternative CO limit under Tier II must be established during the test burn based on the average overall runs of the highest hourly rolling average for each run.

1. Use of a CO Limit to Control PICs.

Generally accepted combustion theory holds that low CO flue gas levels combined with low CO flue gas levels combined with low excess oxygen levels indicate a boiler, industrial furnace, or incinerator is operating at high combustion efficiency. Operating under high combustion efficiency helps to ensure minimum emissions of unburned (or incompletely burned) organics. In the first stage of the combustion of hazardous waste fuel, the POHCs thermally decompose in the flame to form other, usually smaller, compounds termed products if incomplete combustion. In this first stage of combustion, these PICs also decompose to form CO.

The second stage of combustion involves the oxidation of CO to $CO_2$ (carbon dioxide). The CO to $CO_2$ step is the slowest (rate-controlling) step in the combustion process because CO is considered to be more thermally stable (difficult to oxide) than other intermediate products of the combusion of hazardous waste constituents. Because fuel is being fired continuously, these combusion stages occur simultaneously.

Thus, in the waste combustion process, the "destruction" of POHCs is independent of the flue gas CO levels. CO flue gas levels cannot be correlated with DREs for POHCs, and may also not *correlate* well with PIC destruction. Although some emissions data indicate a weak correlation between CO and PICs, the data generally indicate that there is a relationship between the two parameters: When CO is low, PIC emissions are relatively low. The converse may not hold: when CO is high, PICs may or may not be high.

Low CO is an indictaor of the status of the CO to $CO_2$ conversion process, the last rate-limiting oxidation process. Because oxidation of CO to $CO_2$ occurs atter the destruction of a POHS and its (other) intermediates (PICs), the absence of CO is a useful indication of POHC and PIC destruction. The presence of high levels of CO in the flue gas is a useful indication of inefficient combustion, and at some level of elevated CO flue gas concentration, is an indication of the failure of the PIC and POHC destruction process.

EPA believes it is necessary to limit CO levels to levels that are indicative of high combustion efficiency because the precise CO level that indicates significant failure of the PIC and POHC destruction process is not known. In fact, this critical CO level may depend on site-specific and event-specific factors (e.g., fuel type, fuel mix, air-to-fuel ratios, and the rate and extent of changes in these and other factors that affect combustion efficiency). EPA believes that limiting CO levels is also reasonable because:

(1) It is a widely practiced approach for monitoring combustion efficency—some boilers and industrial furnaces are already equipped with CO monitors, and many are equipped with flue gas oxygen monitors; (2) the monitors may pay for themselves through fuel savings resulting from operation of the boiler or industrial furnace closer to maximum combustion efficiency; and (3) well-designed and well-operated boilers and industrial furnaces can readily be operated in conformance with either the 100 ppmv CO limit under Tier I, or the 20 ppmv HC limit under Tier II.

2. Tier I PIC Controls: 100 ppmv CO Limit

*a. Basis for the 100 ppmv CO Limit.* The May 6, 1987 proposed rule would have applied the same CO emission limits to all boilers and industrial furnaces: a lower limit of 100 ppmv over an hourly rolling average and a 500 ppmv limit over a 10-minute rolling average. The hazardous waste feed would be shut off automatically if either limit was exceeded. However, the hazardous waste would be cutoff immediately once the 500 ppmv limit was exceeded while the waste feed would be cutoff within 10 minutes if the 100 ppmv limit was exceeded. Further if the hazardous waste feed was cutoff more than 10 times in a month, the proposed rule would have prohibited further hazardous waste burning pending review and approval by enforcement officials. The lower limit of 100 ppmv was selected as representative of steady-state high efficiency combustion conditions resulting in PIC emissions that would not pose a significant risk. The higher limit of 500 ppmv was proposed to limit the frequency of emission spikes that inevitably accompany routine operational "upsets," such as load changes and start-ups of waste firing.

While two commenters stated that the proposed 100 ppmv CO limit is arbitrary, six commenters supported the Tier I CO limit of 100 ppmv. One commenter supported both the 100 ppmv CO limit over an hourly rolling aver-

age, and the 500 ppmv CO limit over a 10-minute rolling average. Three additional commenters also expressed support for the 500 ppmv CO limit over a 10-minute rolling average. Three other commenters supported a 500 ppmv CO limit over an hourly rolling average, and stated that a maximum 1,000 ppmv CO limit can be included in addition to a 10-minute average.

Many commenters opposed the CO trigger limits and associated limits on the number of waste feed cutoffs proposed in May 1987. Primarily, commenters objected to one set of CO emission limits as applicable to all boilers and industrial furnaces. Further, they argued that PIC emissions will not be significant if, when the waste feed is cutoff, the combustion chamber temperatures are maintained while the waste remains in the chamber. Six commenters argued that the trigger limits will result in increased $NO_x$ emissions. One commenter stated that $NO_x$ and CO cannot be lowered simultaneously, and added that many low $NO_x$ boilers may not be able to meet these CO limits. As an alternative, one commenter stated that a higher Tier I CO limit should be allowed for less toxic emissions; however, this commenter did not provide an alternative approach for identifying the toxicity of emissions. One commenter suggested that EPA retain two alternatives to the CO standard: establishing an alternative standard based on nonmethane, ethane hydrocarbon (NMEHC) emissions, and a case-by-case risk assessment approach.

As a result of these and other comments and further evaluation, EPA is promulgating the Tier I limits based on a maximum hourly rolling average CO limit of 100 ppmv, corrected to 7 percent flue gas oxygen content. If this limit is exceeded, the hazardous waste feed must be automatically and immediately cutoff. The final rule does not restrict the number of waste feed cutoffs because: (1) Combustion chamber temperatures must be maintained after a cutoff; and (2) the number of cutoffs will

be minimized by allowing CO concentrations to be averaged over a 60-minute period (i.e., the hourly rolling average) and by the recommended use of pre-alarms to provide time to remedy the problem or to allow a staged waste cutoff before reaching the CO limit. Nonetheless, the Agency retains the authority to limit the frequency of cutoffs as the facts warrant. See § 266.102(e)(7)(ii). The final rule does not include the proposed 500 ppmv rolling average over a 10-minute limit on CO because we do not believe it is needed given that the final rule requires immediate waste feed cutoff when the 100 ppmv hourly rolling average limit is exceeded. In addition, several commenters argued that the 500 ppmv limit was arbitrary.

In addition, EPA is promulgating alternative (Tier II) standards (discussed below), as discussed in the October 1989 supplemental notice, for control of PIC emissions from boilers and industrial furnaces. The Agency believes that the alternative controls will allow facilities flexibility in meeting both the PIC controls and $NO_x$ emissions standards (imposed under different regulatory authorities) simultaneously. The Agency believes that the alternative, Tier II standards for control of PIC emissions are needed to address issues and concerns raised by commenters on the proposed rule.

The 100 ppmv CO limit promulgated today for Tier I is indicative of steady-state (i.e., normal), efficient combustion conditions. The time-weighed average for the CO limit is provided to accommodate the CO spikes that inevitably occur during routine "upsets," such as when hazardous waste fuel firing starts, when there is a load change on an industrial boiler, or when the composition of fuels varies. Given that CO is a sensitive indicator of overall combustion conditions, and that it may be a conservative indicator of POHC and PIC destruction, EPA is implementing CO control limits based on time-weighted averages of exceedances rather than implementing fixed

CO limits. Fixed limits that do not acknowledge inevitable CO spikes and that do not give owners and operators time to adjust combustion conditions actually could result in greater emissions of PICs because each time hazardous waste firing is interrupted, CO concentrations increase, and emissions of incompletely burned organics may also increase. (Note, however, that there is a requirement to maintain combustion chamber temperature after a waste feed cutoff while waste remains in the chamber that is intended to minimize HC emissions after a cutoff.) Thus, any controls on CO must balance the effects of organic emissions that may result from overly stringent CO limits that require frequent waste feed interruptions with the effects of emissions resulting from less stringent controls that acknowledge inevitable CO spikes.

The Agency has considered whether the 100 ppmv CO limit is, in fact, too stringent given that we acknowledge the limit was chosen from within the range of reasonable values that may be considered indicative of good combustion conditions—50 to 250 ppmv. We attempted to obtain CO/time profiles from a number of well-operated devices to determine the percentage of time the facilities operated within particular CO ranges.[19] We thought to use this data to predict the frequency of waste feed cutoffs that would be required at various CO limits. Unfortunately, the analyses could not be conducted because the facilities we evaluated were operating under specific CO limits and their CO levels never exceeded those limits when burning hazardous waste. We found that the facilities learned to comply with the CO limits they had to meet.

Moreover, we believe that the 100 ppmv CO limit is reasonable for a number of reasons. Not only is it within

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[19] Energy and Environmental Research Corporation, "Guidance on Metal and PIC Emissions from Hazardous Waste Incinerators", Final Report, September 21, 1990.

the range of CO levels that are indicative of good combustion conditions, but the Agency believes that it is not too low because: (1) It is higher than the technology-based 50 ppmv CO level EPA requires for boilers burning waste PCBs (see 40 CFR part 761); (2) it is higher than the CO limits included in many hazardous waste incinerator permits;[20] (3) the Agency explicitly encourages the use of pre-alarms to minimize the frequency of automatic waste feed cutoffs;[21] and (4) the limit is implemented on an hourly rolling average basis which allows and minimizes the effects of short-term CO spikes.

We aslo note that the Agency may soon promulgate regulations for municipal waste combustors (MWCs) that, among other controls, may limit CO concentrations to 50, 100, or 150 ppmv (as proposed), depending on the type of MWC, over a four hour rolling average and dry-corrected to 7% oxygen. The MWC limits are technology-based—they represent levels readily achievable by well-designed and well-operated units. EPA does not believe that the MWC limits present a conflict with the 100 ppmv (with provisions for an alternative higher limit if HC concentrations are less than 20 ppmv) limit for BIFs under today's rule. The Agency is confident that the BIF rule is protective because the Agency has determined that, when CO levels are less than 100 ppmv, PIC emissions do not pose significant risk. Thus, although the 100 ppmv limit is not a best demonstrated technology-based limit (many BIFs (and hazardous waste incinerators) readily operate at CO levels well below 100 ppmv),

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[20] We note that the Agency proposed on April 27, 1990 to apply to hazardous waste incinerators the same CO/HC limits that today's rule applies to BIFs.

[21] If the CO limit is "too low" for a given facility's design and operating conditions, then frequent waste feed cutoffs may occur. Frequent waste feed cutoffs may actually increase PIC emissions because the resulting perturbation to the combustion system may upset the termperature, oxygen, fuel relationships need for complete combustion.

the 100 ppmv CO limit will ensure protection of human health and the environment.

As stated above, the CO limits are based on a flue gas oxygen content of 7 percent. One commenter indicated that EPA's reasoning for using the CO correction of 7 percent oxygen is not clear. The commenter believes the 7 percent correction factor is unfair for thermal units which, under normal conditions, need to operate at oxygen levels greater than 7 percent, yet operate with low levels of CO and HCs. EPA believes that correcting CO levels for flue gas oxygen content is necessary because without this correction, high CO flue gas concentrations could be diluted by high rates of excess oxygen. In today's rule, EPA is requiring that CO be corrected to a flue gas oxygen content of 7 percent because the majority of boilers and industrial furnaces achieve high combustion efficiency at optimum flue gas oxygen levels ranging from 3 percent to 10 percent. The optimum oxygen level to achieve high combustion efficiency for a given device will vary depending on factors such as fuel mix and boiler load. In general, large combustion devices (in terms of heat input capacity) have optimum oxygen requirements on the low end of the range of oxygen content, while smaller units require higher oxygen levels, EPA believes that a correction level of 7 percent is reasonable since this oxygen level is in the middle of the range of typical operation for all devices and since the majority of devices burning hazardous waste fuels have moderate heat input capacities (e.g., 20-150 MM Btu/hr). In addition, 7 percent oxygen is the reference level for the existing particulate standard for hazardous waste incinerators under 40 CFR 264.343(c).

Moreover, the oxygen level to which CO values are corrected is not significant since the CO levels for all facilities are corrected to a common basis. If the oxygen correction level were changed from 7% to some other value, then theoretically, the CO limit would have to be

adjusted accordingly, and the effect on individual facilities would remain the same.

b. Implementation of the 100 ppmv CO Limit. The procedures used to implement the 100 ppmv CO limit are discussed below, including oxygen and moisture correction, format of the limit, and compliance with the limit.

*Oxygen and Moisture Correction.* The CO limit under Tier I (and Tier II) is on a dry gas basis corrected to 7 percent oxygen. The oxygen correction normalizes the CO date to a common base, accounting for the variation in design and operation of the various combustion devices. In-system leakage, facility size, and waste feed type are other factors that cause oxygen concentrations to vary widely in flue gases and were considered in selection of the oxygen correction factor. The correction for moisture normalizes the CO data that results from the different types of CO monitors used at facilities (e.g., extractive, in situ, etc.). EPA's evaluation indicates that application of the oxygen and moisture corrections can change measured CO levels by a factor of two in some cases.

Measured CO levels must be corrected continuously for the amount of oxygen in the stack gas according to the formula:

$$CO_c = CO_m \times 14/(E - Y)$$

Where:

$CO_c$ is the corrected concentration of CO in the stack gas, $CO_m$ is the measured CO concentration according to guidelines specified in Methods Manual for Compliance with the BIF Regulations (Methods Manual)[22], E is the percentage of oxygen contained

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[22] U.S. EPA, *Methods Manual for Compliance with the BIF Regulations,* December 1990. Available from the National Information Service NTIS), 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4600. The document number is PB 91-120-006.

in the air used for combustaion, and Y is the measured oxygen concentration on a dry basis in the stack. Oxygen must be measured at the same stack location at which CO is measured under procedures that are also provided in the Methods Manual.

*Format of the CO Limit.* EPA proposed that the CO limits be implemented under either of two alternative formats, the hourly rolling average format or the time-above-a-limit format. Under this approach, applicants would select the preferred approach on a case-by-case basis. Comments were received in support of both alternative formats. Based on further evaluation of the two formats and for reasons explained below, EPA is requiring use of the hourly rolling average format for compliance with this rule.

Under the hourly rolling average format, a facility must measure and record CO levels as an hourly rolling average. This approach allows instantaneous CO peaks without requiring a cutoff provided that at other times during the previous hour CO levels were correspondingly below the limit. This approach requires a CO monitoring system that can continuously measure and adjust the oxygen correction factor and compute the hourly rolling averages.

Under the proposed time-above-a-limit format, dual CO limits would be established in the permit: the first as a never-to-exceed limit and the second as lower limit for cumulative exceedances of no more than a specified period of time in an hour. These limits and the time duration of the exceedances would be established on a case-by-case basis by equating the mass emissions (peak areas) in both the formats (time-above-a-limit and hourly rolling average formats) so that the regulation would be equally stringent in both cases. The instruments needed for the time-above-a-limit format would include a CO monitor, a recorder, and a timer that could indicate the cumulative time of exceedances in every clock hour, at the end of

which it would be recalibrated (manually or electronically). Oxygen would not be measured continuously in this format; instead an oxygen correction factor would be determined from operating data collected during the trial burn. Subsequently, oxygen correction factors would be determined annually or at more frequent intervals specified in the facility permit.

EPA has re-examined the time-above-the-limit format in light of several comments received and has decided to delete this alternative in today's final rule because:

1. Since a facility would not be required to measure oxygen continuously under this format, there would be no assurance that a facility would be operated reasonably close to the oxygen level at which it operated during the trial burn. Even with a daily determination of an oxygen correction factor, there would be the possibility of "gaming" by the facility (operating the facility at low oxygen levels during the short test period when the oxygen is measured, getting a favorable correction factor established on the basis, and thereafter letting the facility operate at high oxygen levels). Since the major advantage of this format was the cheaper cost due to the omission of the oxygen cost due to the omission of the oxygen monitoring requirement, adding continuous oxygen monitoring to this format would remove this advantage as well; and

2. The proposed computations for converting hourly rolling averages to this format would be cumbersome, inexact, and above all, very restrictive. To obtain a conservative conversion, a permit writer would have to assume that CO levels will remain at the established never-to-exceed limit for the full specified time in the hour, and at the lower established limit the rest of the time. The CO limits obtained by these computations would be very restrictive. As an example, a conversion of a Tier I limit

of 100 ppmv hourly rolling average for a facility having a single CO excursion of 4-minutes duration in which the peak level was 1,000 ppmv, would result in a permit specifying that for the remaining 56 minutes, CO could not exceed 34 ppmv, a very restrictive limit. For example, a CO profiile of 38 ppmv for 55 minutes and 40 ppmv for the remaining 5 minutes would result in a violation.

*Compliance with the Tier I CO Limit.* The Agency considered a number of alternative approaches for evaluating CO readings during trial burns to determine compliance with the 100 ppmv limit, including: (1) The time-weighted average (or the average of the hourly rolling averages); (2) the average of the highest hourly rolling averages for all trial burn runs; or (3) the highest hourly rolling average. The time-weighted average alternative provides the lowest CO level that could reasonably be used to determine compliance, and the highest hourly rolling average alternative provides the highest CO level that could reasonably be used. EPA is requiring the use of the most conservative of these approaches, the highest hourly rolling average approach, for interpreting trial burn CO emissions for compliance with the 100 ppmv Tier I limit. (This approach is conservative because trial burn CO levels are compared to the maximum CO allowed under Tier I—100 ppmv.) EPA believes this conservative approach is reasonable since compliance with the Tier I CO limit allows applicants to avoid the Tier II requirement of evaluating HC emissions to provide the additional assurance (or confirmation) that HC emissions do not exceed levels representative of good operating practice.

3. Tier II PIC Controls: Limits on CO and HC

*a. Need for Tier II PIC Controls.* Commenters indicated that several types of boilers and many cement kilns will not be able to meet the (Tier I) 100 ppmv CO limit

proposed in May 1987 even though HC concentrations will not be high at elevated CO levels. For example, boilers that burn residual oil or coal typically operate with CO emission levels above the Tier 1 100 ppmv CO limit because of inherent fuel combustion characteristics, equipment design constraints, routine transient combustion-related events, requirements for multiple fuel flexibility, and requirements for compliance with $NO_x$ emission standards established under the Clean Air Act. Attempts to reduce CO emissions from these devices to meet the Tier I limit could prove unsuccessful. In addition, there is a possibility that thermal efficiency could be adversely affected if these attempts are successful.

Similarly, industry and trade groups for the cement industry voiced strong opposition to the 100 ppmv CO limit for cement kilns. These commenters indicated that some cement kilns, especially modern precalciners, routinuely emit CO above the Tier I 100 ppmv limit. In general, commenters indicated that while the Tier I limit may be appropriate for combustion devices in which only fuel (fossil or hazardous waste) enters the combustion chamber, it is inappropriate for cement kiln and other product kilns in which massive amounts of feedstocks are processed. These feedstocks can generate large quantities of CO emissions which are unrelated to the combustion efficiency of burning the waste and fuel. Whereas all the CO from boilers and some industrial furnaces is combustion-generated, the bulk of the CO from product kilns can be the result of process events unrelated to the combustion conditions at the burner where wastes are introduced.[23] Therefore, limiting CO emissions from these combustion devices to the Tier I 100 ppmv level may be difficult and may not be warranted as a means of minimizing risk from PICs.

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[23] For example, CO can be generated from the trace levels of organic matter contained in the raw materials as the materials move down the kiln from the "cold" feed end to the "hot" end where the fuel and waste is fired and the product is discharged.

In summary, commenters argued that these are specific instances and classes of combustion devices for which the Tier I CO limit would be difficult or virtually impossible to meet, and thus this limit is inappropriate since EPA has not established a direct correlation between CO emissions, PIC emissions, and health risks.

In light of these concerns, commenters suggested that EPA establish CO limits for specific categories of combustion devices based on CO levels achieved by units operating under best operating practices (BOP). The Agency considered this approach but determined that equipment-specific CO trigger limits would be difficult to establish and support and would not necessarily provide adequate protection from PIC emissions. Nonetheless, EPA believes that the CO limits should be flexible to avoid major economic impacts on the regulated community since no direct correlation has been established between exceeding the 100 ppmv CO limit and increasing health risks from PIC emissions. EPA believes, however, that at some elevated CO level PIC emissions would pose significant risk. At this time, EPA is unable to identify a precise CO trigger level since the trigger level may vary by the type and design of the combustion device and the fuel mix used in the device. Consequently, EPA has established a two-tiered approach to control PICs. Under Tier I, CO is limited to 100 ppmv or less, as discussed above. Under Tier II, CO levels can exceed 100 ppmv provided that the owner or operator demonstrate that the HC concentration in the stack gas does not exceed a good operating practice-based limit of 20 ppmv (except that the Director may establish under § 266.104(f) an alternative HC limit for furnaces that feed raw material containing organic matter and, thus, cannot meet the 20 ppmv limit).

Under Tier II, the CO limit for a facility is based on the levels achieved during a successful compliance test. The Agency originally proposed two alternative ap-

proaches for establishing HC emission limits under the Tier II waiver: a health-based approach and a technology-based approach. These two alternatives and EPA's rationale for selecting the technology-based approach for the final rule are discussed below. Before moving to those discussions, however, it may be useful to summarize the conclusions of an evaluation by EPA's Science Advisory Board of the proposed PIC controls.

*b. Comments by EPA's Science Advisory Board (SAB).* We present below a summary of SAB's conclusions [24] on the scientific support for EPA's proposed PIC controls and EPA's response:

• *SAB*: The Agency has not documented that PICs from hazardous waste combustion can cause significant health risk to human health or the environment.

—*EPA Response:* While the Agency agrees that available data do not show that PICs are likely to pose a significant health risk, EPA's emissions testing to date has been able to identify and quantify only as much as 60% of the organic compounds being emitted during any test. During many of EPA's test's, less than 5 to 10% of organic emissions were characterized. The Agency is concerned that this large fraction of uncharacterized organic emissions could be comprised of compounds that can pose significant health risk. Therefore, the Agency believes that PICs have the potential to present a hazard and should be controlled.

• *SAB:* It is prudent to control PICs given the inability to show that they do not pose a health risk because of limitations of sampling and analytical techniques and health and environmental impact assessment data and methodologies.

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[24] U.S. EPA, "Report of the Products of Incomplete Combustion Subcommittee of the Science Advisory Board", Report #EPA-SAB-EC-90-004, January 1990.

—*EPA Response:* The Agency agrees. Additional emissions testing cannot be used to determine if, in fact, PICs can pose significant risk because the sampling and analytical techniques are not available to identify the unknown compounds. Moreover, even if the techniques were available, health effects data are not likely to be available for the compounds so that a risk assessment could not be conducted.

• *SAB:* The use of CO and HC to ensure high combustion efficiency seems to be a reasonable approach to control PIC emissions.

• *EPA Response:* The Agency agrees.

• *SAB:* Under the Tier II controls when CO exceeds 100 ppmv, HC should be monitored continuously.

—*EPA Response:* The Agency agrees. Today's final rule requires continuous HC monitoring under the Tier II controls (see § 266.104(c)) when CO levels exceed 100 ppmv, and for certain industrial furnaces irrespective of CO level (see §§ 266.104(d) for permit furnaces and 266.103(a)(5) for furnaces operating under interim status).

• *SAB*: There is no scientific support for the health-based approach to establish HC limits on a site-specific basis based on a calculated "unit risk" value for total HC and stack gas monitoring of HC concentrations.

—*EPA Response*: The final rule does not allow the use of the proposed health-based approach to control HC. HC are controlled under the technology-based limit of 20 ppmv. See § 266.104(c).

• *SAB:* The risk assessment procedures are adequate, however, to show that the technology-based HC limit of 20 ppmv appears to be protective of human health.

—*EPA Response:* The Agency agrees.

• *SAB:* The agency should show that the proposed limits for CO and HC do not result in frequent automatic waste feed cutoffs that may increase PIC emissions.

—*EPA Response:* See discussion in section B.2.a above.

Thus, the SAB supported the overall reasonableness of the course adopted in this rule to control potential risks from emissions of PICs.

*c. Health-Based Approach for HC Limits.* Under the Tier II health-based approach, the Agency proposed to allow applicants to demonstrate that PIC emissions from combustion devices pose an acceptable risk (i.e., less than $10^{-5}$) to the maximum exposed individual (MEI). Under this approach, EPA proposed to require that applicants quantify HC emissions during trail burns and assume that all hydrocarbons are carcinogenic compounds with a unit risk value that would be calculated based on available data. The HC unit risk value would be $1.0 \times 10^{-5}$ $m^3$/ug and would represent the adjusted 95th percentile weighted (i.e., by emission concentration) average unit risk of all the hydrocarbon emission data in EPA's database of field testing of boilers, industrial furnaces, and incinerators burning hazardous waste. The weighted unit risk value for HC considers emissions data for carcinogenic PICs (e.g., chlorinated dioxins and furnans, benzene, chloroform, and, carbon tetrachloride) as well as data for PICs that are not suspected carcinogens and are considered to be relatively nontoxic (e.g., methane, and other C1 as well as C2 hydrocarbons.[25]

The Agency proposed to implement this provision by back-calculating an acceptable HC emission rate (and, based on stack gas flow rates, a HC concentration) from the acceptable ambient level based on the calculated

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[25] Additional information on the development of the unit risk factor can be found in U.S. EPA. Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators, October 1988.

"total HC" unit risk value discussed above and allowing an incremental cancer risk of 1 in 100,000.

A number of commenters supported the health-based approach while several others pointed out that the approach was seriously flawed. EPA's Science Advisory Board reviewed the approach as discussed above and concluded that the site-specific, health-based approach of controlling HC was not scientifically supportable.

Upon re-evaluation, EPA believes that basing the HC limit on a health-based approach is not supportable and, thus, has not selected this approach for the final rule. Given the limited data base on the types and concentrations of PICs emitted over a range of operating conditions, we are concerned that the potency value that the proposed approach would apply to the total mass of hydrocarbons emitted may not be appropriate. It is not clear whether the proposed potency value may overstate or understate the risk posed by HC emissions. In addition, we are concerned that we do not fully understand what types of hydrocarbon emissions are actually detected by the continuous monitoring equipment. For example, as we discussed at proposal, certain halogenated compounds are under reported by the HC detection system. Finally, as we noted at proposal, the proposed risk-based approach could allow extremely high HC concentrations —concentrations clearly indicated of combustion upset conditions.

*d. Technology-Based Approach:* 20 ppmv HC Limit. Under the technology-based approach, the Tier I CO limit of 100 ppmv will not have to be met if HC levels in the stack gas do not exceed a good operating practice-based limit of 20 ppmv [26] (measured on an hourly rolling aver-

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[26] As discussed at proposal, the 20 ppmv limit represents a demarcation between good and poor combustion conditions based on HC emissions data from 24 facilities. The 20 ppmv limit is not based on best operating practice. A *best* operating practice limit would be set a level on the order of 5 ppmv.

age basis, reported as propane, dry corrected to 7% oxygen). As noted above, EPA developed this technology-based approach because of current scientific concerns (seconded by the SAB) related to a health-based approach. In addition, the health-based approach could allow HC levels of several hundred ppmv, levels that are clearly indicative of "upset" combustion conditions. The approach, as noted above, lacks a firm scientific basis and could allow facilities to operate under upset conditions. EPA would not authorize such operations unless reasonably certain they would not pose a significant risk to human health and the environment. Such reasonable certainty does not exist here.

One commenter agreed that the PIC standard should be protective without imposing a technology "fix." Although EPA believes the development of a health-based approach is a step in the right direction, the Agency is concerned about whether the health-based Tier II approach is adequately protective given the limited database on PIC emissions and the uncertainty as to what fraction of organic emissions would be detected by the HC monitoring system. Despite the limitations of the HC health risk assessment methodology, EPA believes (and the SAB concurs) it is reasonable to use this methodology to predict whether a technology-based limit appears to be protective. Accordingly, EPA used the health risk assessment methodology to show that a 20 ppmv HC limit would not result in an incremental lifetime cancer risk to the hypothetical maximum exposed individual greater than 1 in 100,000.

The final rule establishes limits for both CO and HC under the Tier II PIC controls. The CO limit is established as the aevrage over all runs of the highest hourly rolling average for each run of the compliance test or trial burn. To demonstrate compliance with the HC limit, the highest hourly rolling average HC level during

the compliance test or trial burn cannot exceed 20 ppmv (except as otherwise provided for furnaces feeding raw materials containing organic matter), reported as propane, corrected 7% oxygen on a dry basis.

The Agency considered whether to establish provision for a case-by-case waiver of the 20 ppmv HC limit based either on health-risk assessment or technical feasibility (i.e., feasibility of providing combustion conditions to minimize fuel-generated HC). The final rule does not provide for a waiver of the 20 ppmv HC limit as an indicator of good combustion conditions and minimum fuel-generated PIC emissions. (The final rule does, however, allow the Director to establish under the part B permit proceedings an alternative HC limit for industrial furnaces (e.g., cement kilns, light-weight aggregate kilns) to account for hydrocarbons that are emitted from trace levels of organic matter in the raw material. Any alternative HC limit established for a furnace will ensure that fuel-generated hydrocarbons (hazardous waste and other fuels) are less than 20 ppmv by establishing the HC limit based on HC concentrations when the system is designed and operated under good combustion conditions without burning hazardous waste.[27] See section II.B.5 of Part Three of this preamble for more discussion of the alternative HC limit for industrial furnaces.)

EPA did not provide a waiver of the HC limit in the final rule because: (1) The Agency believes, and SAB concurs, that a site-specific, health risk assessment approach to establishing HC limits (e.g., a waiver of the 20 ppmv limit) is not scientifically supportable; and (2) a technology-based waiver is not supportable because well-designed and operated hazardous waste combustion devices can readily meet a 20 ppmv HC limit.

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[27] We note that this approach should limit fuel-generated hydrocarbon concentrations to well below 20 ppmv because fuel-generated hydrocarbons from a well-designed and operated cement or lightweight aggregate kiln should not exceed 5 ppmv.

Several commenters disagreed with EPA that both CO and HC should be monitored, stating that it is unnecessary to monitor CO if HC is monitored. The Agency continues to believe that it is reasonable to require both CO and HC monitoring when CO levels exceed 100 ppmv. When CO levels exceed the Tier I level, the facility is not operating at high combustion efficiency and the potential for high PIC emissions exists. The Agency believes that, since CO monitoring is a widely practiced approach for improving and monitoring combustion efficiency, and since CO emission levels may respond more quickly to process upsets than HC levels, the apparent redundancy in requiring both CO and HC monitoring is warranted to ensure protection of human health.

Another commenter added that HC monitoring could be supplemented by frequent testing for common PICs that respond poorly to HC monitors, such as carbon tetrachloride, formaldehyde, perchlorethylene, and chlorobenzene. At this time, the Agency believes that continuous HC monitoring combined with CO monitoring is adequate in most cases to detect when the facility is operating under combustion upset conditions (this is another reason, however, that monitoring both CO and HC is reasonable when CO levels exceed the level normally indicative of good combustion—100 ppmv). We note that, as discussed in section II.D below the final rule requires a hot HC monitoring system (i.e., unconditioned gas sample heated to a minimum of 150°C) which ensures minimum loss of organic compounds. Nonetheless, the Agency is currently developing sampling and analytical techniques to continuously monitor indicator organic compounds such as those suggested by the commenter.

*e. Basis for Final Rule.* EPA believes that the 20 ppmv HC limit in the final rule for the Tier II PIC controls is representative of an HC limit that distinguishes between good and poor combustion conditions. (When a facility operates under poor combustion conditions, PIC emissions can increase and may result in adverse health

effects to exposed individuals.) This HC limit is within the range of values reported in the Agency's data base for hazardous waste incinerators, boilers, and industrial furnaces that burn hazardous waste, and the limit is also protective of human health based on risk assessments conducted for 30 incinerators. See 54 FR 43723. Under Tier II, HC must be monitored continuously, recorded on an hourly rolling average basis, reported as ppmv propane, and corrected to 7 percent oxygen on a dry basis. In addition, CO must be monitored continuously, corrected to 7 percent oxygen on a dry basis, recorded on an hourly rolling average basis, and may not exceed the limit established during the test burn (i.e., the average over all runs of the highest hourly rolling average for each run).

4. Special Requirements for Furnaces

The final rule provides several special requirements for industrial furnaces stemming from the fact that: (1) Some industrial furnaces, notably cement kilns, are not able to meet the 20 ppmv HC limit because trace levels of organic matter in raw materials can emit substantial levels of hydrocarbons; and (2) the PIC controls may not be protective for furnaces (e.g., cement kilns and mineral wool cupolas) that feed hazardous waste at locations other than where normal fuels are fired. These special requirements are discussed below.

*a. Alternative HC Limit,* EPA requested comment on whether alternative HC limits may be appropriate for certain industrial furnaces. See 54 FR 43724 (Oct. 26, 1989) A number of commenters [28] requested that EPA

[28] In addition to comments on the October 26, 1989 supplement to the proposed rule, see minutes of the EPA meetings with the Cement Kiln Recycling Coalition of April 17, 1990; May 23, 1990; June 4, 1990; June 20, 1990; July 19, 1990; and October 10, 1990. See also minutes of the EPA meeting with Southdown, Inc. on May 11, 1990, and the letter from the Cement Kiln Recycling Coalition to Bob Holloway, EPA, dated June 15, 1990.

allow cement kilns, lightweight aggregate kilns, and lime kilns that cannot meet the 20 ppmv HC limit because of the hydrocarbons generated by trace levels of organic materials in the normal raw materials to establish a site-specific alternative HC limit that does not allow HC levels when burning hazardous waste to be significantly higher than when burning normal fuels, processing normal raw materials, and producing normal products in a system that is designed and operated to minimize hydrocarbon concentrations in stack gas. Nineteen commenters pointed out that baseline HC emission levels from cement kilns can be attributed to the naturally-occurring raw materials that are used in the production of cement. Use of shale as a raw material, for example, can result in HC emissions from kerogens in the shale. Use of fly ash as a source of iron and silica could result in increased CO emissions from partial oxidation of free carbon in the fly ash. Commenters claim that approximately 6 to 10 cement plants may not be able to comply with the HC limit of 20 ppmv even though they generate minimal HC from sources other than raw materials (e.g., hazardous waste fuels, other fuels, organic compounds in slurry water). The organic compounds in normal raw materials would not ordinarily be hazardous, so that their emissions (e.g., through volatilization) would not raise the types of concerns normally addressed by RCRA.[29]

The Agency believes that it will be possible in some situations to develop an approach on a case-by-case basis to effectively implement an alternative HC limit under the principle stated above. (If the 20 ppmv HC limit were health-based, the Agency would be more reluctant to develop an alternative to it. Given, however, that the limit is a measure of combustion efficiency, the Agency believes it reasonable to develop an alternative means for

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[29] We noted, however, that nonhazardous organic constituents in feedstreams may be partially combusted to form hazardous products of incomplete combustion.

this class of furnaces to demonstrate combustion efficiency.) The Agency considered a number of approaches to establish an alternative HC level and determined in the time available that none appeared to be workable in all situations. The Agency is therefore adopting a more individualized approach in the present rule that allows permit writers to establish an alternative HC limit (i.e., a HC limit that exceeds 20 ppmv) in a facility's operating permit, and allows permit writers to grant an extension of time to comply with the HC limit during interim status, based on the following showings: (1) For cement kilns, the kiln is not equipped with a by-pass duct that meets the requirements of § 266.104(f)(1); (2) the applicant demonstrates that the facility is designed and operated to minimize hydrocarbon emissions from fuels and raw materials; (3) the applicant develops an approach to effectively monitor over time changes in the operation of the facility that could reduce baseline HC levels—for example, changes in raw materials, fuels, or operating conditions—which could result in establishing a new baseline and corresponding adjustment of the HC limit; and (4) the applicant demonstrates that the hydrocarbon emissions are not likely to pose a significant health risk. See § 266.104(f)(2). We explain these provisions in more detail below, along with an explanation of which provisions apply during interim status and which are part of permit application and issuance.

*Interim Status Facilities.* Today's rule requires facilities operating in interim status to comply with CO and, if required, a 20 ppmv HC limit within 18 months of the rule's date of promulgation. The rule provides for a case-by-case extension from these requirements (as well as the particulate, metals, and $HCl/Cl_2$ standards) "if compliance is not practicable for reasons beyond the control of the owner or operator." See § 266.103(c)(7)(ii). The situation where a furnace may be unable to achieve the 20 ppmv HC limit because of organics present at baseline conditions (i.e., when the facility is designed and

operated to minimize HC emissions from raw materials and fuels while producing normal products under normal operating conditions and when no hazardous waste is burned) may be eligible for the extension of time provided the following conditions are satisfied:

1. The applicant for the extension of time must have submitted a complete part B permit application. The application must include the following information pertinent to the question of an alternative HC limit: (a) Documentation that the system is designed and operated to minimize HC emissions from all sources when the baseline level is established and when hazardous waste is burned; (b) documentation of the baseline HC flue gas concentrations when the facility is operated to minimize HC emissions and when feeding normal raw materials and normal fuels to produce normal products under normal operating conditions and when not burning hazardous waste; (c) a test protocol to confirm the baseline HC (and CO) level; (d) a trial burn protocol to demonstrate that, when hazardous waste is burned, HC (and CO) concentrations do not exceed the baseline level; and (e) a procedure to show if and when HC emissions from nonhazardous waste sources may decrease (in which case, the overall HC limit might be adjusted downward after a new baseline is established). See § 270.22(b). (The substantive basis for these requirements is explained in more detail below.)

2. During interim status, the applicant must not only conduct emissions testing when burning hazardous to certify compliance with all remaining emissions control—dioxins and furans, PM, metals, and $HCl/Cl_2$—but also establish and comply with interim limits on CO and HC presented in the part B permit application as levels the applicant has determined by testing (without burning hazardous waste) are baseline levels. We note that the Director may not have

time during the review of the extension request (and a preliminary review of the part B application) to confirm the adequacy of the interim CO and HC limits proposed by the applicant. Moreover, to do so would require the types of oversight of test protocols, emissions testing, and review of data that will be applied under the permit process. Thus, the interm limits are subject to revision based on (confirmation) testing in support of the operating permit. Nonetheless, EPA believes that establishing interim CO and HC limits and requiring the owner/operator to comply with them until a permit is issued (or denied) is reasonable and provides a measure of protection of human health and the environment.

It should be noted that the Agency does not believe that it is possible to establish an alternative HC limit during interim status. This is because the level of interaction between an applicant and permit writer over evaluation of the various protocols to establish a HC baseline and determine when it should be reduced, plus conducting test burns to confirm the HC baseline and that HC levels do not increase when hazardous waste is burned, plus conducting a health-risk assessment for organic emissions when hazardous waste is burned are beyond the scope of interim status. Consequently, the rule is structured so that the alternative HC limit (if warranted) would be established as part of the permit, and the interim status certification of compliance deadline can be extended, if the Director finds this is warranted, while the permit is being processed. The Director may also make the extension of time conditional on the time estimated to process the permit application or other factors, and can be conditioned on operating conditions than ensure the facility will operate in a manner that protects human health and the environment. Any such condition would be embodied in an interim status extension determination that is en-

forceable as a requirement of subtitle C (much as conditions in a closure plan are enforceable), and would be documented in an administrative record for the determination.

3. Cement kilns with a by-pass duct meeting the requirements of § 266.104(g)(2) are ineligible for an extension. The rule precludes cement kilns operating with a by-pass duct from eligibility for the extension of the certification of compliance date for compliance with the CO and HC limit, as well as for obtaining an alternative HC limit in a permit.

*Fully Permitted Facilities.* The Director may establish an alternative HC limit in the facility's operating permit provided that the applicant meets the following requirements. Information and data documenting compliance with these requirements must be included in the part B permit application. See § 270.22(b). First, the applicant must document in the permit application that facility is designed and operated to minimize HC emissions from all sources, including raw materials and fuels. Examples of situations where the system is not designed and operated to minimize HC (and CO) levels during baseline testing are when: (1) Coal is mixed with raw material which is fed into a cement kiln preheater such that the coal can contribute to HC emissions; (2) cement kiln slurry water contains enough organic compounds to significantly contribute to HC emissions; (3) waste fuels such as tires are burned in a manner that could contribute to HC emissions; (4) the furnace is not operated and designed to minimize emissions of hydrocarbons emitted from raw material (in general, the more quickly the raw material is exposed to elevated temperatures, the lower the hydrocarbon emissions); and (5) normal fuels are not burned under good combustion conditions.

Second, the applicant must propose in the permit application baseline flue gas CO and HC levels. These proposed baseline levels also serve as interim values under

which the facility must operate under a conditional time extension for certification of compliance with the HC standard until permit issuance (or denial). The proposed baseline levels must be supported by emissions testing under baseline conditions (i.e., when the facility is designed and operated to minimize HC emissions from raw materials and fuels while producing normal products under normal operating conditions and when no hazardous waste is burned). Baseline levels must be determined from test data as the average over all valid runs of the highest hourly rolling average value for each run. This is the same approach specified by the rule to determine limits on other operating parameters (e.g., maximum feed rate limits, maximum temperatures, etc.). EPA believes that this approach is workable for cement kilns [30] given that commenters have asserted that when hazardous waste is burned, hydrocarbon levels do not increase and often decrease. As discussed in section II.E of Part Three of the preamble, HC levels from a cement kiln with HC levels of 66 to 70 ppmv when burning coal decreased to 38 to 63 ppmv when burning hazardous waste fuel. If the facility cannot install continuous monitors for HC (and CO and oxygen) in time to conduct these baseline tests prior to submittal of the permit application (which must be sufficiently prior to 13 months after promulgation of the rule to give the Director time to consider whether to grant the time extension), the facility may use portable monitors. We note that the HC monitoring system must be a hot, unconditioned system. In addition, we note that different baseline values may be necessary for different modes of operation if the baseline HC (or CO) level changes significantly under those modes of operation. Examples are when the raw material mix is changed

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[30] Although any industrial furnace that cannot meet the 20 ppmv HC limit because of organic matter in raw material is eligible to apply for an alternative HC limit, only one commenter expressed concern that industrial furnaces other than cement kilns may not be able to meet the 20 ppmv HC limit.

to make a different cement product or when different fuels are burned.

Third, the applicant must develop emissions testing protocols to: (1) Confirm the baseline HC and CO levels proposed in the permit application (and under which the facility must operate in interim status upon receipt of an extension of time to comply with the HC limit and until an operating permit is issued (or denied)); and (2) to demonstrate that, when hazardous waste is burned, HC and CO levels do not exceed baseline levels (and emissions of other pollutants do not exceed allowable levels). If a baseline HC or CO level is to be established for more than one mode of operation, a baseline confirmation test (comprised of at least three valid runs) must be run for each mode.

Fourth, the applicant must develop an approach to effectively monitor over time changes in the operation of the facility that could significantly reduce baseline HC or CO levels. If baseline levels are significantly reduced, then the alternative HC and CO limits that apply when burning hazardous waste must also be reduced. Such changes could include: (1) Changes in the concentration of organic matter in raw materials; (2) changes in the concentration of organic matter in the raw material mix due to changes in the mixture of raw materials needed to produce different types of product; (3) changes in fuels; and (4) changes in the concentration of organic compounds in slurry water used for a wet cement kiln. The approach must be workable and enforceable.

EPA is requiring this condition in order to avoid establishing a high baseline which is then reduced without also lowering the HC limit, potentially allowing the hazardous waste to be burned under poor combustion conditions creating high, but undetected, HC levels (i.e., hazardous waste could be burned under poor combustion conditions and could be emitting high HC levels eevn though the HC limit was not exceeded). (The Agency notes that the problem is establishing a HC baseline and for determin-

ing when the baseline might change for this type of industrial furnace is more difficult than determining when the raw material baseline changes in documenting when co-combustion of hazardous waste with raw materials in a Bevill device might affect the composition of residues. See section XIII of Part Three of the preamble. This is because, in the case of the HC baseline, not only must the raw materials' and fuels' composition be monitored, but the units design and operating conditions as well to determine whether the baseline has changed. Thus, the rule provides for more interaction in establishing baseline conditons and determining when they change for assessing alternative HC limits for cement kilns than it does when making determinations as to whether co-combustion of hazardous waste can remove residues from eligibility for exclusion under the Bevill amendment.)

Finally, EPA is concerned that hazardous waste burning may affect the type and concentration of organic compounds emitted from an industrial furnace that has elevated HC concentrations attributable to raw materials. For example, the chlorine in the hazardous waste may result in higher concentrations of chlorinated organic compounds. Therefore, the rule requires the owner or operator, as part of the permitting process, to use state-of-the-art emissions testing procedures and risk assessment to demonstrate that organic emissions are not likely to pose unacceptable health risk. The owner or operator must conduct emissions testing during the trial burn to identify and quantify the organic compounds listed in appendix VIII, part 261, that may be emitted using test procedures specified by the Director on a case-by-case basis. As noted above, although EPA does not believe such risk-based approaches to be adequate as the basis for a national risk-based PIC standard, we think the approach is part of the best means of assuring that cement kilns combust hazardous waste fuels properly in those instances where HC levels are greater than 20 ppmv as a result of organics in normal raw material feed.

Two sampling and analysis approaches that the Director may use are discussed below. One protocol involves the following steps to identify and quantify concentrations of organic compounds in stack emissons:

1. Sample volatile organc compounds using the VOST train of Method 0030 as prescribed in SW-846. Analytical work is conducted using GC/MS according to Method 5040 in SW-846.

2. Sample semi-volatile organic compounds using the sampling train prescribed in Method 0010 in SW-846. Analytical work is conducted using GC/MS according to Method 8270 in SW-846.

3. Sample aldehydes and ketones using an impinger train with 2-4-di-nitro-phenyl hydrazine. (2-4-DNPH) in the impinger solution as prescribed in Method 0011 in the *Methods Manual*, and analysis of impinger solution by high performance liquid chromatography (HPLC) as specified in "Analysis for Aldehydes and Ketones by High Performance Liquid Chromatography" in the *Methods Manual*.

Another protocol is a screening approach that has been described in the literature [31] that uses the following protocols as specified in SW-846: [31]

1. Soxhlet extraction sample preparation;

2. Gas chromatography (GC) coupled with flame ionization detector (FID) or mass spectrography (MS) screening;

3. Total chromatographic organics (TCO) and gravimetric (GRAV) procedures; and

4. High performance liquid chromatography-ultraviolet/MS (HPLC-UV/MS) screening and compound identification.

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[31] Johnson, Larry, et al., "Screening Approach for Principal Organic Hazardous Constituents and Products of Incomplete Combustion", JAPCA Journal, Volume 39, No. 5, May 1989.

To select an appropriate protocol, the Director will consider the state-of-the-art of sampling and analytical techniques and the expected nature of organic emissions considering emissions data or other information.

We note that, under this PIC risk assessment, emission rates must also be determined for the 2,3,7,8-chlorinated tetra-octa congeners of chlorinated dibenzo-*p*-dioxins and dibenzofurans (CDDs/CDFs) using Method 23, "Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDFs) from Sationary Sources" in Methods Manual for Compliance with the BIF Regulations (Methods Manual), incorporated in today's rule as appendix IX of part 266. The risks from these congeners must be estimated using the 2,3,7,8-TCDD toxicity equivalence factor prescribed in "Procedures for Estimating the Toxicity Equivalence of Chlorinated Dibenzo-p-Dioxin and Dibenzofuran Congeners" in Methods Manual.

The owner or operator must then conduct dispersion modeling to predict the maximum annual average ground level concentration of each such organic compound. On-site ground level concentrations must be considered if a person resides on-site; otherwise, only off-site concentrations may be considered. Dispersion modeling must be conducted in conformance with EPA's Guideline on Air Quality Models, EPA's "Hazardous Waste Combustion Air Quality Screening Procedure" provided in Methods Manual, or EPA's Screening Procedures for Estimating Air Quality Impact of Stationary Sources. The Methods Manual and the Guideline on Air Quality Models are incorporated in today's rule as appendices IX and X, respectively, to part 266. The Screening Procedures document is incorporated by reference in § 260.11.

Stack heights exceeding good engineering practice (GEP, as defined in 40 CFR 51.100(ii)) may not be used to predict ground level concentration. See section V.B.1.c of Part Three of this preamble.

If the owner or operator applies for an alternative hydrocarbon limit for more than one industrial furnace such that emissions from the furnaces are from more than one stack, emissions testing must be conducted on all such stacks and dispersion modeling must consider emissions from all such stacks.

To demonstrate that the noncarcinogenic organic compounds listed in appendix IV of the rule do not pose an unacceptable health risk, the predicted ground level concentrations cannot exceed the levels established in that appendix.

To demonstrate that the carcinogenic organic compounds listed in appendix V of the rule do not pose an unacceptable health risk, the sum of the ratios of the predicted ground level concentrations to the levels established in the appendix cannot exceed 1.0. This is because the acceptable ambient levels established in appendix V are based on a $10^{-5}$ risk level. To ensure that the summed risk from all carcinogenic compounds does not exceed $10^{-5}$ (i.e., 1 in 100,000) the sum of the ratios described above must be used. (We note that the 2,3,7,8-TCDD toxicity equivalency factor is to be used to estimate the risk from 2,3,7,8-chlorinated CDDs/CDFs, and the risk from these congeners must be added to the risk from other PICs to ensure that the summed risk does not exceed 1 in 100,000.)

To demonstrate that other compounds for which the Agency does not have adequate health effects data to establish an acceptable ambient level are not likely to pose a health risk, the predicted ambient level cannot exceed 0.1 $\mu g/m^3$. This is the 5th percentile lowest reference air concentration for the compounds listed in appendix IV of the rule.

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5. Special Considerations for Cement Kilns

*a. Monitoring in the By-Pass Duct of a Cement Kiln.* The final rule provides that cement kilns with by-pass ducts may monitor CO and, if required, HC concentrations in the by-pass duct. Most precalciner and some preheater kilns are equipped with by-pass ducts where a portion (e.g., 5-30%) of the kiln off-gas is diverted to a separate air pollution control system (APCS) and, sometimes, a separate stack. A portion of the kiln gases are so diverted to avoid a build-up of metal salts that can adversely affect the calcination process. Dust collected from the by-pass APCS is usually disposed of while dust collected from the main APCS is usually recycled back into the kiln to make the clinker product.

Several comments were received regarding sampling at cement kilns. Five commenters suggested that HC (and CO) measurements should be allowed in the by-pass duct rather than in the main stack because: (1) The by-pass gas is representative of the kiln off-gas; and (2) this approach would preclude the problem of nonfuel HC emissions from the raw material exceeding the 20 ppmv limit. The raw material would be heated and partially calcined in the precalciner or preheater and HC from that process would be emitted from the main stack. The by-pass duct draws the kiln off-gas prior to the precalciner or preheater and, so, would not be affected by that process.

Another commenter specifically supported monitoring CO (and HC, if required) only in the bypass duct provided that hazardous waste is fed only to the kiln and not to the preheater or precalciner.

The Agency conducted testing [34] at a cement kiln to gather information relevant to the issue of HC monitoring in the bypass duct for preheater and precalciner cement

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[34] U.S. EPA, "Emissions Testing of a Precalciner Cement Kiln at Louisville, Nebraska", November 1990.

kilns. The data showed that the gases in the bypass duct are representative of the combustion of waste in the kiln.

Based on this test data and public comment, the final rule allows CO and, where required, HC monitoring in the bypass duct of a cement kiln provided that: (1) Hazardous waste is fired only into the kiln (i.e., not at any location downstream from the kiln exit relative to the direction of gas flow); and (2) the bypass duct diverts a minimum of 10% of kiln off-gas. See § 266.104 (g). The 10% diversion requirement is based on engineering judgment that, at this level of kiln-gas diversion, the bypass gas will be representative of the kiln off-gas. Industry representatives indicate [35] that the bypass duct capacity of most facilities actively involved in burning hazardous waste exceeds the 10% limit.

*b. Use of Hazardous Waste as Slurry Water for Wet Cement Kilns.* Some kiln operators have inquired as to what regulatory standards apply, if any, if hazardous wastes are used as slurry water. The Agency does not regard the practice as an excluded form of recycling. The Agency has long been skeptical of claims that hazardous wastes are "recycled" when they substitute for very commonly available and economically marginal types of raw materials. In particular, the Agency has been skeptical that liquid hazardous wastes serve as a substitute for water. Cf. 48 FR at 14489 (April 4, 1983). In the case of hazardous waste used as slurry water, the hazardous constituents in the waste are ordinarily unnecessary to the claimed recycling activity and are being gotten rid of through the slurrying process. Given the possibility of hazardous levels of air emission is high, the practice certainly can be part of the waste disposal problem. Consequently, the Agency regards such practice as a form of waste management subject to regulation under today's rule.

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[35] Letter dated August 16, 1990, from Dr. Michael von Seebach, Southdown, Inc., to Dwight Hlustick, EPA.

EPA considered prohibiting the use of hazardous waste as slurry water for wet cement kilns because of concern that toxic organic constituents in the waste could be volatilized and emitted without complete combustion. The final rule does not prohibit using (or mixing) hazardous waste with slurry water because we believe that the controls provided by the rule both during interim status and under a RCRA operating permit adequately address the hazard that the practice may pose.

If hazardous waste is fed into any industrial furnace during interim status at a location other than the hot, product discharge end, combustion gas temperatures must exceed 1800 F° at the point of introduction, and the owner or operator must document that adequate oxygen is present to combust organic constituents in the waste. See discussion above. EPA believes that these restrictions will, as a practical matter, preclude use of hazardous waste in slurry water during interim status.

Although these restrictions on hazardous waste burned at locations other than the hot end of an industrial furnace do not apply under a RCRA operating permit, the permit proceedings will ensure that organic constituents in a hazardous waste that is fed into the kiln in slurry water (or in the slurry itself) will be destroyed. The Director will require that toxic nonmetal constituents in the waste are destroyed to a 99.99% destruction and removal efficiency, and that adequate oxygen is present to completely destroy the organic compounds.

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III. List of Subjects in 40 CFR Parts 260, 261, 264, 265, 266, 270, and 271

Administrative practices and procedures, Confidential business information, Hazardous materials transportation, Hazardous waste, Indian lands, Insurance, Incorporation by reference, Intergovernmental relations, Packaging and containers, Penalties, Recycling, Reporting and record-

keeping requirements, Security measures, Security bonds, Water pollution control, Water supply.

Dated: December 31, 1990.

F. Henry Habicht II,

*Deputy Administrator and Acting Administrator.*

## APPENDIX D

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 261, 264 and 270

[FRL-3358-6 EPA/OSW/FR/90-007]

RIN 2050-AB90

Standards for Owners and Operators of Hazardous Waste Incinerators and Burning of Hazardous Wastes in Boilers and Industrial Furnaces

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule, supplemental proposed rule, technical corrections, and request for comments.

SUMMARY: Under this proposal, the Environmental Protection Agency (EPA) would amend the hazardous waste incinerator regulations to improve control of toxic metal emissions, hydrogen chloride emissions, and residual organic emissions; amend the definitions of incinerators and industrial furnaces; propose definitions for plasma arc incinerators and infrared incinerators; propose to regulate carbon regeneration units as thermal treatment devices; and make a number of minor revisions to permitting procedures.

At present, toxic metal emissions from incinerators are controlled indirectly by a limitation on particulate matter. Under some conditions, the particulate standard may not sufficiently control toxic metals to ensure adequate protection of human health. Under today's proposal, EPA would establish risk-based emission limits for individual toxic metals in addition to the existing particulate standard.

Under existing rules, hydrogen chloride emissions are controlled by a technology-based standard. Because that standard may under-regulate emissions in particular situa-

tions, risk-based emissions limits would be established in addition to the existing standard.

In addition, organic emissions that result from inadequate combustion of toxic organic hazardous wastes are controlled under present rules by a destruction and removal efficiency (DRE) standard. The DRE standard requires destruction of toxic organic constituents in the waste, but does not directly control products of incomplete combustion. To address the potential health risk from products of incomplete combustion, today's proposed rule would require that incinerators continuously operate at high combustion efficiency by establishing limits on flue gas carbon monoxide and hydrocarbon levels.

Finally, EPA is noticing corrections as well as requesting comment on three regulatory alternatives to issues presented in the October 26, 1989 supplement to the proposed rule for burning hazardous waste in boilers and industrial furnaces (54 FR 43718). These items are set forth in part One, section III.C of this notice. The issues of concern are: regulation during interim status of the direct transfer of hazardous waste from a transport vehicle to a boiler or furnace; controls on emissions of free chlorine; and limiting stack gas temperature at the inlet to a dry emissions control device to below 450 °F.

DATES: EPA will accept public comments on this proposed rule and on the other issues opened for public comment by this notice until June 26, 1990.

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## IV. Proposed Controls for Emissions of Products of Incomplete Combustion

### *A. Hazard Posed by Emissions of Products of Incomplete Combustion (PICs)*

The burning of hazardous waste containing toxic organic compounds listed in Appendix VIII of 40 CFR part 261 under poor combustion conditions can result in sub-

stantial emissions of compounds that result from the incomplete combustion of constituents in the waste, as well as emissions of the original compounds which were not burned. The quantity of toxic organic compounds emitted depends on the concentration of the compounds in the waste, and the combustion conditions under which the waste is burned.

Data on typical PIC emissions from hazardous waste combustion sources were compiled and assessed in recent EPA studies.[53] [54] These studies identified 37 individual compounds in the stack gas of the eight full-scale hazardous waste incinerators tested, out of which 17 were volatile compounds and 20 semivolatile compounds. Eight volatile compounds (benzene, toluene, chloroform, trichloroethylene, carbon tetrachloride, tetrachloroethylene, chlorobenzene, and methylene chloride), and one semivolatile compound (naphthalene) were identified most frequently in over 50 percent of the tests. Some of these compounds are carcinogenic. It was found that PIC emission rates vary widely from site-to-site which may be due, in part, to variations in waste feed composition and facility size. The median values of the nine compounds mentioned above range from 0.27 to 5.0 mg/min. Using a representative emission rate of 1 mg/min, the stack gas concentration for PICs in a medium-sized facility (250 $m^3$/min combustion gas flow rate) would be 4 $\mu g/m^3$ (0.004 $\mu g/l$).

The health risk posed by PIC emissions depends on the quantity and toxicity of the individual toxic compo-

[53] Wallace, D. et al., "Products of Incomplete Combustion from Hazardous Waste Combustion," Draft Final Report, EPA Contract No. 68-03-3241, Acurex Corporation, Subcontractor No. ES 59669A, Work Assignment 5, Midwest Research Institute Project No. 8371-L(1), Kansas City, MO, June 1986.

[54] Trenholm, A., and C. C. Lee, "Analysis of PIC and Total Mass Emissions from an Incinerator," Proceedings of the Twelfth Annual Research Symposium on Land Disposal, Remedial Action, Incineration, and Treatment of Hazardous Waste, Cincinnati, OH, April 21-23, 1986, EPA/600-9-86/022, pp. 376-381, August 1986.

nents of the emissions, and the ambient levels to which persons are exposed. Estimates of risk to public health resulting from PICs, based on available emissions data, indicate that PIC emissions do not pose significant risks when incinerators are operated under optimum conditions. However, incinerator do not always operate under optimum conditions. In addition, only limited information about PICs is available. PIC emissions are composed of thousands of different compounds, some of which are in very minute quantities and cannot be detected and quantified without very elaborate and expensive sampling and analytical (S&A) techniques. Such elaborate S&A work is not feasible in trial burns for permitting purposes and can only be done in research tests. In addition, reliable S&A procedures simply do not exist for some types of PICs (e.g., water-soluble compounds). The most comprehensive analysis of PIC emissions from a hazardous waste incinerator identified and quantified only approximately 70 percent of organic emissions. Typical research-oriented field tests identify a much lower fraction—from 1-60 percent. Even if all the organic compounds emitted could be quantified, there are inadequate health effects data available to assess the resultant health risk. EPA believes that, due to the above limitations, additional testing will not, in the foreseeable future, be able to prove quantitatively whether PICs do or do not pose unacceptable health risk. Considering the uncertainties about PIC emissions and their potential risk to public health, it is therefore prudent to require that incinerators operate at a high combustion efficiency to minimize PIC emissions. Given that carbon monoxide (CO) is the best available indicator of combustion efficiency, and a conservative indicator of combustion upset, we are proposing to limit the flue gas CO levels to levels that ensure PIC emissions are not likely to pose unacceptable health risk. In cases where CO emissions exceed a proposed *de minimis* limit, higher CO levels would be allowed under two alternative approaches: (1) if hydrocarbon (HC) concentrations in the stack gas do not exceed a good operating practice-

based limit of 20 ppmv; or (2) if the applicant demonstrates that HC emissions are not likely to pose unacceptable health risk using conservative, prescribed risk assessment procedures. Although we prefer the technology-based approach for reasons discussed below, we are requesting comment on the health-based alternative as well.

*B. Existing Regulatory Controls*

Section 264.345 of the existing regulations requires that the permit must limit the CO level in the stack exhaust gas based on the trial burn when demonstrating conformance with the destruction and removal efficiency (DRE) standard for principal organic hazardous constituents (POHCs). Section 264.347 requires that CO emissions be monitored continuously at a point downstream of the combustion zone and prior to release to the atmosphere; and § 264.345 requires that the incinerator must be equipped with a functioning system to cut off the waste feed automatically when the CO limit is exceeded. Thus, the existing regulations do not specify an upper limit for CO, but rather limit CO to the levels that occur during the trial burn. The regulations do not specify limits for PIC emissions nor require analysis of risks from such emissions. PICs are assumed to be controlled by the DRE standard for POHCs. Although CO levels may often be at levels that represent high combustion efficiency (e.g., below 100 ppmv, the *de minimis* limit proposed today) when demonstrating conformance with the DRE standard, there is no assurance that such low CO levels will always occur. Test data indicate that 99.99 percent DRE can be achieved when incinerators (and boilers and industrial furnaces) are operating under upset combustion conditions as evidenced by high CO stack gas levels and even smoke. Apparently, organic constituents in the waste are readily destroyed in the flame zone, but combustion by-products or PICs may not be exposed to adequate time, temperature, and turbulence to be reduced to low levels. Thus, existing regulatory provisions may not be adequate to ensure that PICs do not pose unacceptable risk.

*C. Basis for CO Standards*

EPA is proposing to limit flue gas carbon monoxide levels to ensure that incinerators that burn hazardous waste operate at high combustion efficiency to reduce the potential risk from emissions of PICs. EPA believes that a CO level of 100 ppmv represents high combustion efficiency operations that would virtually ensure that PIC emissions are limited to levels that pose acceptable risk to public health. However, all incinerators (e.g., those that handle containers of volatile waste or that have fluid beds) may not be able to readily meet a 100 ppmv CO limit. Because we have not been able to establish a direct correlation between CO, PIC emissions, and the resulting health risk (i.e., when CO is 150 or 200 ppmv we are uncertain if PIC emissions are likely to pose significant risk), we are proposing an approach to waive the CO limit of 100 ppmv. Under the waiver, any CO level achieved during the DRE trial burn would be allowed provided that emissions of hydrocarbons (HC) do not exceed acceptable levels.

1. *Summary of Proposed Controls.* EPA is proposing a two-tiered approach to control PICs by limiting stack of gas CO levels. The first tier requires compliance with a CO limit of 100 ppmv on an hourly rolling average[55] basis. If a facility meets this CO level, during the trial burn, 100 ppmv will be the permit limit. If this CO limit cannot be met, the facility could operate at higher permitted CO levels under a Tier II waiver. The 100 ppmv CO limit would be waived under two alternative approaches: (1) a demonstration that hydrocarbon (HC) emissions are not likely to pose unacceptable health risk using conservative, prescribed risk assessment procedures; or (2) a technology-based demonstration that the HC concentration in the stack gas does not exceed a good

[55] An hourly rolling average is the arithmetic mean of the 60 most recent 1-minute average values recorded by the continuous monitoring system.

operating practice-based limit of 20 ppmv. Although we prefer the technology-based approach for reasons discussed below, we request comment on the health-based alternative as well.

The CO limits for either Tier I or Tier II must be corrected to dry stack gas and 7 percent oxygen in the stack gas. The correction to dry gas is necessary only for instruments that measure CO on a wet basis. This correction factor for humidity would initially be determined during the trial burn and annually thereafter unless specified otherwise in the permit. The oxygen correction factor must be determined at intervals specified in the permit (not less frequently than annually). The oxygen and humidity correction factors would be applied continuously. (The basis for the 7 percent oxygen correction factor is discussed in section IV, C.4 below.)

The existing regulations already require that the hazardous waste feed must be cutoff automatically when the permitted CO limits are exceeded. Today's proposal adds a requirement that hazardous waste burning may be resumed when CO levels are brought within the permitted limits. When the hazardous waste feed is cut off, combustion chamber temperatures specified in the permit and the air pollution control equipment functions must be maintained as long as any waste remains in the combustion chamber. For incinerators with a secondary combustion chamber, we request comment on whether temperatures should be maintained in both the primary and secondary chambers to control organic emissions when the waste feed is cutoff. Auxiliary fuels used to maintain temperatures must not contain hazardous waste other than waste exempt from the substantive requirements of subpart O under provisions of § 264.340(b).

EPA specifically requests comment on how to apply the requirement to maintain temperature following a waste feed cutoff, as well as other standards proposed today, to batch incinerators.

2. *Use of CO Limits to Ensure Good Combustion Conditions.* By definition, low CO flue gas levels are indicative of an incinerator (or any combustion device) operating at high combustion efficiency. Operating at high combustion efficiency helps ensure minimum emissions of unburned (or incompletely burned) organics.[56] In a simplified view of combustion of hazardous waste, the first stage is immediate thermal decomposition of the POHCs in the flame to form other, usually smaller, compounds, also referred to as PICs. These PICs are generally rapidly decomposed to form CO.

The second stage of combustion involves the oxidation of CO to $CO_2$ (carbon dioxide). The CO to $CO_2$ step is the slowest (rate controlling) step in the combustion process because CO is considered to be more thermally stable (difficult to oxide) than other intermediate products of combustion of hazardous waste constituents. Since fuel is being fired continuously, both combustion stages are occurring simultaneously.

Using this view of waste combustion, CO flue gas levels cannot be correlated to DRE for POHCs and may not correlate well with PIC destruction. As discussed below, test data show no correlation between CO and DRE, but do show a slight apparent correlation between CO and chlorinated PICs, and a fair correlation between CO and total unburned hydrocarbons. Low CO is an indicator of the status of the CO to $CO_2$ conversion process, the last, rate-limiting oxidation process. Since oxidation of CO to $CO_2$ occurs after destruction of the POHC and its (other) intermediates (PICs), the absence of CO

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[56] Given that CO is a gross indicator of combustion performance, limiting CO may not absolutely minimize PIC emissions. This is because PICs can result from small pockets within the combustion zone where adequate time, temperature, and turbulence have not been provided to oxidize completely the combustion products of the POHCs. Available data, however, indicate that PIC emissions do not pose significant risk when combustion devices are operated at high combustion efficiency. EPA is conducting additional field and pilot scale testing to address this issue.

is a useful indication of POHC and PIC destruction. The presence of high levels of CO in the flue gas is a useful indication of inefficient combustion and, at some level of elevated CO flue gas concentration, an indication of failure of the PIC and POHC destruction process. We believe it is necessary to limit CO levels to levels indicative of high combustion efficiency because we do not know the precise CO level that is indicative of significant failure of the PIC and POHC destruction process. It is possible that the critical CO level may be dependent on site-specific and event-specific factors (e.g., fuel type, air-to-fuel ratios, rate and extent of change of these and other factors that affect combustion efficiency). We believe limiting CO levels is prudent because: (1) it is a widely practiced approach to improving and monitoring combustion efficiency; and (2) most well designed and operated incinerators can easily be operated in conformance with the proposed Tier I CO limits of 100 ppmv.

The Tier I CO limit proposed today specifies a 100 ppmv CO limit in the permit even though the CO level during the trial burn will be lower (i.e., by definition, under Tier I). EPA considered this issue carefully and the proposal is based on three considerations. First, DRE will not be reduced below the levels specified in § 264.343 (a)(1) for POHCs by the proposed CO limits. Second, many incinerators run very efficiently during a trial burn and indicate less than 10 ppmv of CO emissions. It may not be possible to achieve that high degree of efficiency on a consistent basis and specifying such low trial burn CO values may result in numerous hazardous waste feed cut-offs due to CO exceedances. Third, the emission of PICs from incinerators has not been shown to increase linearly at such low CO levels. In fact, the trial burn data indicate that total organic emissions are consistently low (i.e., at levels that pose acceptable health risk) when CO emission levels are less than 100 ppmv. Two studies show that no measurable change in DRE is likely to occur for CO levels up to 100 ppmv. The first study generated

data from combustion of a 12 component mixture in a bench scale facility.[57] The CO levels ranged from 15 to 522 ppmv without a significant correlation to the destruction efficiency for the compounds investigated. The second study was conducted on a pilot scale combustor.[58] Test runs were conducted with average CO concentrations ranging from 30 to 700 ppmv. When the concentration was less than 220 ppmv no apparent decrease in DRE was noticed, but higher CO concentrations showed a definite decrease in DRE. EPA specifically invites comments on whether the permit should limit CO according to trial burn values in lieu of the limits specified here.

3. *Supporting Information on CO as Surrogate for PICs.* Substantial information is available that indicate CO emissions may relate to PIC emissions.

Combustion efficiency is directly related to CO by the following equation:

$$\text{Combustion Efficiency (CE)} = \frac{\text{percent } CO_2}{\text{percent } CO_2 + \text{percent CO}} \quad (100)$$

CE has been used as a measure of completeness of combustion.[59] EPA's regulations for incineration of waste PCBs at 40 CFR 761.70 require that combustion efficiency be maintained above 99.9 percent. As combination becomes less efficient or less complete, at some point, the emission of total organics will increase and smoke

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[57] Hall D.L. et al. "Thermal Decomposition Properties of a Twelve Component Organic Mixture", Hazardous Wastes & Hazardous Materials, Vol. 3, No. 4 pp 4431-449, 1986.

[58] Waterland, L.R. "Pilot-scale Investigation of Surrogate Means of Determining POHC Destruction" Final Report for the Chemical Manufacturers' Association, ACUREX Corporation, Mountain View, California, July 1983.

[59] We specifically request comments on whether combustion efficiency, as defined above in the text (i.e., considering both CO and $CO_2$ emissions) should be used to control THC emissions rather than CO alone.

will eventually result. It is probable that some quantity of toxic organic compounds will be present in these organic emissions. Thus, CE or CO levels provide an indication of the potential for total organic emissions and possibly toxic PICs. Data are not available, however, to correlate these variables quantitatively with PICs in combustion processes.

Several studies have been conducted to evaluate CO monitoring as a method to measure the performance of hazardous waste combustion. Though correlations with destruction efficiency of POHCs have not been found, the data from these studies generally show that as combustion conditions deteriorate, both CO and total hydrocarbon emissions increase. These data support the relation between CO and increased organic emissions discussed above. In one of these studies,[60] an attempt was made to correlate the concentrations of CO with the concentrations of four common PICs (benzene, toluene, carbon tetrachloride, and trichloroethylene) in stack gases of full scale incinerators. For a plot of CO versus benzene, one of the most common PICs, there is considerable scatter in the data indicating that parameters other than CO affect the benzene levels. However, there is a trend in the data that suggests that when benzene levels are high, CO levels also are high. The converse has not been found to be true; when benzene levels are low, CO levels are not always low. Similar trends were observed for toluene and carbon tetrachloride, but not for trichloroethylene. In the pilot-scale study by Waterland cited earlier, similar trends were observed for chlorobenzene and methylene chloride and in another study[61] similar trends were observed for

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[60] Trenholm, A., P. Gorman, and G. Jungclaus, "Performance Evaluation of Full-Scale Hazardous Waste Incinerators, Vol. 2—Incinerator Performance Results." EPA-600/2-84-181b, NTIS No. PB 85-129518, November 1984.

[61] Chang, D.P. et al., "Evaluation of a Pilot-Scale Circulating Bed Combustor as a Potential Hazardous Waste Incinerator," APCA Journal, Vol. 37, No. 3, pp. 266-274, March 1987.

total chlorinated PICs. These data support the conclusion that when the emission rates of some commonly identified PICs are sufficiently high, it is likely that CO emissions will also be higher than typical levels.

More importantly, however, available data indicate that when CO emissions are low (e.g., under 100 ppmv), PIC emissions are always low (i.e., at levels that pose acceptable health risk). The converse may not be true: when CO is high, PIC levels may or may not be high. Thus, the Agency believes that CO is a conservative indicator of potential PIC emissions and, given that CO monitoring is already required in the present regulations, the emission levels should be limited to low levels indicative of high combustion efficiency. (For those facilities where CO emissions may be high but PIC emissions low, we are providing an opportunity under Tier II of the proposed rule to demonstrate that, in fact, PIC emissions pose acceptable health risks at elevated CO levels.)

*D. Derivation of the Tier I CO Limit.*

The proposed Tier I *de minimis* CO limit of 100 ppmv was selected for a number of reasons: (1) it is within the range of CO levels that represent high combustion efficiency; (2) available field test data indicate that PICs are not emitted at levels that pose unacceptable risks when CO does not exceed 100 ppmv; (3) the 100 ppmv level is consistent with the combustion efficiency of 99.9 percent currently required by EPA's PCB incineration regulations codified at 40 CFR 761.70; (4) it is the CO limit proposed for boilers and furnaces burning hazardous waste (see 52 FR 16997 (May 6, 1987), and 54 FR 43718 (October 26, 1989)); and (5) it is a level that the majority of well designed and operated incinerators can meet. These reasons are discussed below.

EPA regulations referred to above (40 CFR part 761) under the authority of the Toxic Substance Control Act (TSCA) for the incineration of PCB-laden wastes require

a minimum combustion efficiency (CE) of 99.9 percent. Combustion efficiency of 99.9 percent, calculated as $CO_2/(CO_2+CO)$, translates to CO emissions levels of 80 to 125 ppmv corrected to 7 percent $O_2$, depending on the fuel C/H ratio. The intent of the PCB combustion efficiency rule is to minimize emissions of potentially toxic organics. Therefore, the proposed 100 ppmv CO level for hazardous wastes destruction is consistent with the intent of the regulations governing the incineration of PCB wastes.

CO emission data from hazardous waste incineration research and trial burn tests also confirm the relationship between CE greater than 99.9 percent and CO levels less than 100 ppmv. The combustion efficiencies in all cases where data were available were calculated to exceed 99.9 percent, except for the test runs where CO exceeded the proposed CO limit.

The data from the research tests of eight incinerators cited earlier [62] showed that most incinerators easily complied with the 100 ppmv proposed limit with two exceptions. The first exception was a maximum hourly average of 120 ppmv which came from one test run out of four at a test site. Information was not available to evaluate why CO levels were higher for this test run; however, all the other three runs at this site showed routine compliance with the proposed limits. The second exception came from data for a rotary kiln that was fed containers of volatile waste. All three runs at this site showed CO levels clearly higher than the proposed limits. This incinerator operated at a relatively higher baseline CO level and also exhibited frequent CO spikes as drums of volatile waste were fed to the rotary kiln.

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[62] Trenholm, A., P. Gorman, G. Jungclaus, "Performance Evaluation of Full-Scale Hazardous Waste Incinerators, Vol. 2—Incinerator Performance Results," EPA-600/2-84-181b, NTIS No. PB 85-129518, November 1984.

Another data set on CO is contained in the results of trial burn tests conducted during permitting of hazardous waste incinerators.[63] Based on an evaluation of these data, we estimate that some incinerators could fail the proposed CO limits. (Under today's proposal, owners and operators of these incinerators would be required to demonstrate that their HC emissions are acceptable). But, in general, the data reviewed suggests that most hazardous waste incinerators can easily achieve the recommended CO limits. Information was not available to evaluate why the CO levels were higher at some incinerators and not at others. Reduction of these higher CO levels may involve relatively simple change in some cases, but may require significant changes in operating conditions in other cases. Comments by incinerator operators have indicated that certain incinerator operators may have difficulty achieving the proposed limits without a substantial reduction in capacity. The type of operations specifically referred to are rotary kiln incinerators that feed containers of volatile waste, and fluidized bed incinerators. Volatile hazardous waste when batch fed in containers can volatilize and burn rapidly creating a momentary oxygen deficiency in the primary combustion chamber. A CO spike generally occurs every time a container in fed in the system and the cumulative spikes could increase the average CO level to go above 100 ppmv. The average CO level is also affected by the volatility of the waste, the quantity of waste fed in one batch, the frequency at which batches are fed, and the volume of the combustion chamber. EPA specifically requests comments from incinerator operators about the achievability of the Tier I CO limit. Comments should include supporting a documentation or data on any of the above issues, including information demonstrating how the device is designed and operated to achieve high combustion efficiency but nonetheless has CO levels exceeding 100 ppmv.

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[63] PEI Associates and JACA Corporation. "Permit Writer's Guide to Test Burn Data—Hazardous Waste Incineration; USEPA Handbook, EPA/625/6-86/012, September 1986.

Low flue gas CO concentration is widely used as an indictaor of "good combustion practices" for waste-to-energy systems. Combustion of municipal waste and refuse derived fuel (RDF) in modern design municipal waste combustors (MWCs) requires sufficient oxygen and mixing at uniformly high furnace temperature to ensure complete combustion of toxic organics, including polychlorinated dibenzo-p-dioxins and furans (PCDD/PCDF). Although, by most technical accounts, CO is not considered directly relatable to PCDD/PCDF emissions from MWCs, the Agency has recently proposed to limit CO levels from MWCs to ensure high combustion efficiency.[64] Limits on CO combined with other requirements are designed to minimize emissions of PCDD/PCDF emissions. The proposed MWC CO limits vary from 50 ppmv to 150 ppmv depending on the type of device, and are calculated on a 4-hr average basis, dry-corrected to 12 percent $CO_2$. The limits are technology-based—they represent levels readily achievable by well-designed and well-operated units. EPA does not believe that the proposed limits of 50 ppmv to 150 ppmv for MWCs presents a conflict with today's proposed 100 ppmv *de minimis* CO emission limit for hazardous waste incinerators. The 100 ppmv limit proposed in today's rule for hazardous waste incinerators can be waived to allow higher CO levels provided that HC levels to not exceed acceptable levels. We did not propose to limit CO to a level lower than 100 ppmv, although readily achievable by many hazardous waste incinerators, because available data indicate that PIC emissions do not pose significant health risk when the CO concentration is 100 ppmv.

*E. Derivation of the Tier II Controls*

If the highest hourly average CO level during the trial burn exceeds the Tier I limit of 100 ppmv, a higher CO level would be allowed if emissions of hydrocarbons

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[64] See 54 FR 52251 (December 20, 1989).

(HC) are considered acceptable under two alternative approaches: a health-based approach, or a technology-based approach. We prefer the technology-based approach for reasons discussed below. One of the alternatives will be selected for the final rule based on public comment and Agency evaluation, including a critique by the Agency's Science Advisory Board (SAB).[65]

1. *Health-Based Approach.* Under the health-based approach to waive the 100 ppmv CO limit, the applicant would be allowed to demonstrate that PIC emissions from the combustion device pose an acceptable risk (i.e., less than $10^{-5}$ [66]) to the maximum exposed individual (MEI). Under this approach, we would require the applicant to quantify total hydrocarbon (THC) emissions during the trial burn and to assume that all hydrocarbons are carcinogenic compounds with a unit risk that has been calculated based on available data. The THC unit risk value would be $1.0 \times 10$—5 $m^3/\mu g$ and represents the adjusted, 95th percentile weighted (i.e., by emission concentration) average unit risk of all the hydrocarbon emissions data in our data base of field testing of boilers, industrial furnaces, and incinerators burning hazardous waste. The weighted unit risk value for THC considers, emissions data for carcinogenic PICs (e.g., chlorinated dioxins and furans, benzene, chloroform, carbon tetrachloride) as well as data for PICs that are not suspected carcinogens and are considered to be relatively nontoxic (e.g., methane, and other $C_1$ as well as $C_2$ pure hydrocarbons, i.e., containing only carbon and hydrogen). We adjusted the data base as follows to increase the con-

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[65] Report of the Products of Incomplete Combustion Subcommittee, Science Advisory Board, U.S. EPA, "Review of the Office of Solid Waste Proposed Controls for Hazardous Waste Incinerators: Products of Incomplete Combustion", October 24, 1989.

[66] In selecting a risk threshold of $10^{-5}$ for these rules, EDA considered risk thresholds in the range of $10^{-4}$ to $10^{-6}$. As discussed in section I.D. of Part Three of the text, the Agency requests comment on alternative risk thresholds.

servatism of the calculated THC unit risk value: (1) we assumed that the carcinogen formaldehyde is emitted from hazardous waste combustion devices at the 95th percentile levels found to be emitted from municipal waste combustors;[67] and (2) we assumed that every carcinogenic compound in appendix VIII of part 261 for which we have health effects data but no emissions data is actually emitted at the level of detection of the test methods, 0.1 $\mu$g/l. Finally, we assigned a unit risk of zero to noncarcinogenic compounds (e.g., $C_1$-$C_2$ hydrocarbons such as methane, acetylene). The calculated unit risk value for THC is $1 \times 10^{-5} m^3/\mu g$, comparable to the value for carbon tetrachloride.[68]

To implement the health-based approach with minimum burden on permit writers and applicants, we have established conservative THC emission Screening Limits as a function of effective stack height, terrain, and land use. See Appendix B of the October 26, 1989, supplemental notice for boilers/furnaces (54 FR 43739). These Screening Limits were back-calculated from the acceptable ambient level for THC, 1.0 $\mu g/m^3$ (based on the unit risk value discussed above and an acceptable MEI risk of $10^{-5}$), using conservative dispersion coefficients. (We also used those dispersion coefficients to develop alternative emissions and feed rate limits for metals and HCI, as discussed elsewhere. The basis for those dispersion coefficients is also discussed elsewhere.) If THC emissions measured during the trial burn do not exceed the THC emissions Screening Limits, the risk posed by THC emissions would be considered acceptable. If the

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[67] Because of its extremely high volatility, special task sampling and analysis procedures are required to measure formaldehyde emissions. Such testing has not been successfully conducted during EPA's field testing of hazardous waste combustion devices.

[68] For additional technical support, see U.S. EPA, "Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators," October 1989 (Draft Final Report).

Screening Limits are exceeded, the applicant would be required to conduct site-specific dispersion modeling using EPA's "Guideline on Air Quality Models (Revised)" to demonstrate that the (potential) MEI exposure level (i.e., the maximum annual average ground level concentration) does not exceed the acceptable THC ambient level.

2. *Technology-Based Approach.* Under this Tier II approach, the Tier I CO limit of 100 ppmv would be waived if HC levels in the stack gas do not exceed a good operating practice-based limit of 20 ppmv.

We have developed this technology-based approach because of concern about current scientific limitations of the risk-based approach. In addition, the risk-based approach could allow THC levels of several hundred ppmv—levels that are clearly indicative of upset combustion conditions.

The Agency believes that risk assessment can and should be used to limit the application of technology-based controls—that is, to demonstrate that additional technological controls, even though available, may not be needed. However, we are sufficiently concerned that our proposed to THC risk assessment methodology may have limitations, particularly when applied to THC emitted during poor combustion conditions (i.e., situations where CO exceeds 100 ppmv), that we are considering a cap on HC emissions. Although we believe the development of risk-based approach is a positive step, we are concerned whether the risk-based approach is adequately protective given our limited data base on PIC emissions and understanding of what fraction of organic emissions would be detected by the HC monitoring system. Notwithstanding the limitations of the THC risk assessment methodology, however, we believe it is reasonable to use the methodology to predict whether a technology-based limit appears to be protective. We have used the risk assessment methodology to show that a 20 ppmv HC limit appears to be protective of public health.

We discuss below our concerns with the proposed THC risk-based approach and the basis for tenatively selecting 20 ppmv as the recommended HC limit (measured with a conditioned gas monitoring system, recorded on an hourly average basis, reported as propane, and corrected to 7% oxygen).

a. *Concerns with the THC Risk Assessment Methodology.* Our primary concern with the risk assessment methodology is that, although it may be a reasonable approach for evaluating PIC emissions under good combustion conditions, it may not be adequate for poor combustion conditions—when CO exceeds 100 ppmv. The vast majority of our data on the types and concentrations of PIC emissions from incinerators, boilers, and industrial furnaces burning hazardous waste were obtained during test burns when the devices were operated under good combustion conditions. CO levels were often below 50 ppmv. Under Tier II applications, CO levels can be 500 to 10,000 ppmv or higher (there is no upper limit on CO).[69] The concern is that we do not know whether the types and concentrations of PICs at these elevated CO levels, indicative of combustion upset conditions, are similar to the types and concentrations of PICs in our data base. It could be hypotesized that as combustion conditions deteriorate, the ratio of semi-and nonvolatile compounds to volatile compounds may increase. If so, this could have serious impacts on the proposed risk assessment methodology. First, the proposed generic unit risk value for THC may be understated when applied to THC emitted under poor combustion conditions. This is because semi- and nonvolatile compounds comprise only 1% of the mass of THC in our data base, but pose 80% of the estimated cancer risk. Thus, if the fraction of semi- and nonvolatile compounds increases under poor combus-

[69] Hazardous waste incenerators have operated at CO levels exceeding 13,000 ppmv during trial burns that achieved 99.99% distributed and removal efficiency.

tion conditions, the cancer risk posed by the compounds may also increase.

To put this concern in perspective, we note that the proposed THC risk value calculated from available data is $1 \times 10^{-5} m^3/\mu g$. This unit risk is 100 times greater (i.e., more potent) than the unit risk for the quantified PICs with the lowest unit risk (e.g., tetrachloroethylene), but 1000 times lower than the risk for PICs such as dibenzoanthracene, and 10,000 to 1,000,000 times lower than the unit risk for various chlorinated dioxins and furans.

Second, if the fraction of semi- and nonvolatile THC increases under poor combustion conditions, the fraction of THC in the vapor phase when entering the THC detector may be lower than the 75% assumed when operating under good combustion conditions.[70] If so, the correction factor for the so-called missing mass would be greater than the 1.33 factor proposed.

The Agency is currently conducting emissions testing to improve the data base in support of the proposed risk-based approach. We are concerned, however, that the testing that is underway and planned may not provide enough information to support the risk-based approach. In particular, we are concerned that our stack sampling and analysis procedures and our health effects data base are not adequate to satisfactorily characterize the health effects posed by PICs emitted under poor combustion conditions.

A final concern with the risk assessment methodology is that it does not consider health impacts resulting from indirect exposure. As explained above, the risk-based standards proposed today consider human health impacts only from direct inhalation. Indirect exposure via uptake through the food chain, for example, has not been con-

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[70] See discussions in US EPA, "Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators," October 1989. (Draft Final Report)

sidered because the Agency has not yet developed site-specific procedures for quantifying indirect exposure impacts for purposes of establishing regulatory emission limits.

b. *Basis for the HC Limit.* We request comment on a HC limit of 20 ppmv as representative of a HC level distinguishing between good and poor combustion conditions. Under this alternative approach, HC would be monitored continuously during the trial burn, recorded on an hourly average basis, reported as ppmv propane, and corrected to 7% oxygen. (See discussion below regarding performance specifications of the HC monitoring system.) We have tentatively selected a level of 20 ppmv because: (1) it is within the range of values reported in our data base for hazardous waste incinerators and boilers and industrial furnaces burning hazardous waste; and (2) the level appears to be protective of human health based on risk assessments using the proposed methodology for 30 incinerators.[71]

The available data appear to indicate that the majority of devices can meet a HC limit of 20 ppmv when operating under good conditions (i.e., when CO is less than 100 ppmv). It appears, in fact, that many hazardous waste incinerators can typically achieve HC levels of 5 to 10 ppmv when operating generally at low CO levels. When incinerators emit higher HC levels typically exceed 100 ppmv, indicative of poor combustion conditions. As discussed in the October 26, 1989, supplemental notice to the boiler furnace proposed rules, the available information on boilers and industrial furnaces is not quite as clear, however. Although the data base indicates that boilers burning hazardous waste can easily meet a HC limit of 20 ppmv, the Agency has obtained data on various types of boilers burning various types of fossil fuels

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[71] Memorandum from Shiva Garg, EPA, to the Docket, entitled "Supporting Information for a GOP-Based THC Limit", dated October 20, 1988.

(not hazardous waste) that indicate that HC levels can exceed 20 ppmv when CO levels are less than 100 ppmv. See footnote 70. We are reviewing that data and obtaining additional information to determine if an alternative limit may be more appropriate for boilers. We specifically request comment on whether a HC concentration of 20 ppmv in fact represents good operating practice for boilers burning hazardous waste as the sole fuel or in combination with other fuels.

We also request comment on whether a HC concentration of 20 ppmv represents good operating practice for industrial furnaces. Preheater and precalciner cement kilns, for example, may not be able to readily achieve such a low HC concentration for the same reason that they typically cannot achieve CO levels below 100 ppmv. Normal raw materials such as limestone can contain trace levels of organic materials that oxidize incompletely as the raw material moves down the kiln from the feed end to the hot end where fuels are normally fired. Clearly, any HC (or CO) resulting from this phenomenon has nothing to do with combustion of hazardous waste fuel. Thus, an incinerator and a preheater or precalciner cement kiln with exactly the same quality of combustion conditions may have very different HC (and CO) levels. We request comment on: (1) the types of industrial furnaces for which a HC level 20 ppmv is representative of good combustion conditions; (2) whether alternative HC limits may be more appropriate for certain industrial furnaces; and (3) whether an approach to identify a site-specific HC limit representative of good operating practices may be feasible (e.g., where HC levels when burning hazardous waste would be limited to baseline HC levels without burning hazardous waste). In support of comments, we request data on emissions of CO and HC under baseline and hazardous waste burning conditions, including characterization of the type and concentration of individual organic compounds emitted.

As mentioned previously, some data on CO and HC levels from industrial boilers burning fossil fuels (not hazardous waste) appear to indicate that HC levels can far exceed levels considered to be representative of good combustion conditions (20 ppmv) even though CO levels are less than 100 ppmv. See footnote 70. If it appears that this situation can, in fact, occur for particular devices burning particular fuels, we would consider requiring both CO and HC monitoring for all such facilities irrespective of whether CO levels were less than 100 ppmv during the trial burn. Thus, under this scenario, the two-tiered CO controls proposed today would be replaced with a requirement to continuously monitor CO and HC for those particular facilities. We specifically request information on the types of facilities where HC levels may exceed 20 ppmv even though CO levels are less than 100 ppmv, and the need to continuously monitor HC for those facilities irrespective of the CO level achieved during the trial burn.

*F. Implementation of Tier I and Tier II PIC Controls*

1. *Oxygen and Moisture Correction.* The CO limits for either format are on a dry gas basis and corrected to 7 percent oxygen. The oxygen correction normalizes the CO data to a common base, recognizing the variation among the different technologies as well as modes of operation using different quantities of excess air. In-system leakage, the size of the facility and the type of waste feed are other factors that cause oxygen concentration to vary widely in incinerator flue gases. Seven percent oxygen was selected as the reference oxygen level because it is in the middle of the range of normal oxygen levels for hazardous waste incinerators and it also is the reference level for the existing particulate standard under § 264.343(c). The correction for humidity normalizes the CO data from the different types of CO monitors (e.g., extractive vs. in situ). Our evaluation indicates that the above two

corrections, when applied, could change the measured CO levels by a factor of two in some cases.

Measured CO levels should be corrected continuously for the amount of oxygen in the stack gas according to the formula:

$$CO_c = CO_m \times \frac{14}{21 - Y}$$

where $CO_c$ is this corrected concentration of CO in the stack gas, $CO_m$ is the measured CO concentration according to guidelines specified in Appendix C, and Y is the measured oxygen concentration on a dry basis in the stack. Oxygen should be measured at the same stack location that CO is measured.

2. *Formats of the CO Limit.* The CO limits under Tier I and Tier II would be implemented under two alternative formats. The applicant would select the preferred approach on a case-by-case basis. Under Format A, CO would be measured and recorded as an hourly rolling average. Under Format B, called the time-above-a-limit format, three parameters would be specified —a never-to-be-exceeded CO limit, and a base CO limit not to be exceeded for more than a specified time in each hour.

In developing these alternative formats, EPA considered three alternative methods:

- A level never to be exceeded;
- A level to be exceeded for an accumulated specified time within a determined time frame; and
- An average level over a specified time that is never to be exceeded.

The first alternative is the simplest and requires immediate shutdown of an incinerator when the limit is exceeded, regardless of how long the CO levels remain high. Short-term CO excursions or peaks (a few min-

utes duration) are typical of incinerator operation and can occur during routine operations; e.g., when a burner is adjusted. It is possible that during shutdown and start-up, the incinerator may momentarily have high CO emissions. Since the total mass emissions under such momentary CO excursions is not high, a never-to-exceed limit would impede incinerator operation while providing little reduction in health risk.

The second alternative, allowing the CO level to exceed the limit for a specified accumulative time within a determined time frame (e.g., x minutes in an hour), solves the problem associated with the first alternative. Incinerators would not be shut down by a single CO peak of high intensity yet they would be restricted from operation with several short interval CO peaks, or a single long duration peak.

The third alternative, allowing the CO level never to exceed an average level determined over a specified time, also avoids the problem of shutting off the waste feed each time an instantaneous CO peak occurs. A time-weighted average value (i.e., integrated area under the CO peaks over a given time period) also provides a direct quantitative measure of mass emissions of CO. For this reason, the use of a rolling average is EPA's preferred format. A combination of the first and second alternatives, with provisions to limit mass CO emissions per unit time, is also proposed as an alternative format. This alternative CO format has been proposed to reduce the cost of instrumentation from that required to provide continuous rolling average CO values corrected for oxygen. This format may be particularly attractive to operators of small or intermittently operated incinerators. The CO monitoring system needed for the first alternative requires continuous measurement and adjustment of the oxygen correction factor and continuous computation of hourly rolling averages. The instrumentation costs of such a system, consisting of continuous CO and oxygen

monitors with back-up systems, a data logger and microprocessor, could be up to $91,000 and would require increased sophistication and operating costs over simpler ssytems. The only instrumentation needed for the alternative time-above-the-limit format is a CO monitor and a timer that can indicate cumulative time of exceedances in every clock hour, at the end of which it is recalibrated (manually or electronically) to restart afresh. Oxygen also would not have to be measured continuously in this format; instead, an oxygen correction value can be determined from operating data collected during the trial burn. Subsequently, oxygen correction values would be determined annually or at more frequent intervals specified in the facility permit.[72] We have not limited the use of this alternative CO format to any size or to any type or class of incinerators since we consider that this alternative format provides an equal degree of control of CO emissions to the rolling average format.

The alternative format would require dual CO levels to be established by the permit writer, the first as a never to exceed limit and the second a lower limit for cumulative exceedances of no more than a specified time in an hour. These limits and the time duration of exceedance shall be established on a case-by-case basis by equating the mass emissions (peak areas) in both the formats so that the regulation is equally stringent in both cases. The Background Document[73] provides the methodology and mathematical formulae showing how this can be done.

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[72] We believe that annual determinations of the oxygen correction factor will be appropriate in most cases because the concern is whether duct in-leakage has substantially changed over time. The fact that excess oxygen levels also change with waste type and feed rate should be considered in establishing the correction factor initially.

[73] US EPA, "Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators," October 1989 (Draft Final Report).

3. *Monitoring CO and Oxygen.* Compliance with the Tier I CO limit would require: (1) continuous monitoring of CO during the trial burn and after the facility is permitted; (2) continuous monitoring of oxygen during the trial burn and, under the 60-minute rolling average format, after the facility is permitted; and (3) measurement of moisture during the trial burn and annually (or as specified in the permit) thereafter. Compliance with the Tier II CO limits would require all the Tier I measurements and measureemnt of HC during the trial burn. Methods for measurements of CO and oxygen, (and THC) must be in accordance with the 3rd edition of SW-846, as amended. The methods are summarized in appendix C of the October 26, 1989, boiler/furnace supplemental notice (see 54 FR 43739-45), and are discussed in more detail in "Proposed Methods for Stack Emissions Measurements of CO, $O_2$, THC, HCl, and Metals at Hazardous Waste Incinerators", U.S. EPA, July, 1989 (Draft Final Report). If compliance with the CO standard is not demonstrated during the DRE trial burn, the CO test burn must be under conditions identical to the DRE trial burn.

4. *Monitoring HC.* Under Tier II, hydrocarbons (HC) would be monitored during the trial burn to ensure that the highest hourly average level does not exceed 20 ppmv. We believe that continuous HC monitoring should also be required over the life of the permit and an exceedance of the HC limit should be linked to automatic waste feed cutoff. This is because at high CO levels (e.g., greater than 100 ppmv) HC levels may or may not be high (e.g., greater than 20 ppmv). The concern is that, although HC levels during the trial burn may be less than 20 ppmv when CO exceeds 100 ppmv, operations over the life of the permit within the envelope allowed by the permit conditions may result in HC levels exceeding 20 ppmv. This concern was expressed by EPA's Science Advisory Board during its critique of the

proposed PIC controls in the spring of 1989.[74] EPA specifically requests comments over whether continuous monitoring of HC should be required over the life of the permit under Tier II.

EPA had developed specifications for HC monitoring (see Appendix D of the October 26, 1989 boiler/furnace supplemental notice (54 FR 43743-45)) that would have required heated gas sampling lines and a heated flame ionization detector (FID) to keep as much of the HC in the vapor phase as possible. EPA reasoned that heated sampling lines were needed because the FID can detect HC only in the vapor phase—condensed organic compounds are not measured. Preliminary results of field testing of a hazardous waste incinerator conducted in July 1988 indicate that detected HC levels were 3 to 27 times greater with a heated FID system compared to an unheated system when CO levels ranged from 100 ppmv to 2760 ppmv.[75] The total mass of volatile, semivolatile, and nonvolatile organic compounds was also quantified during those tests using the Level I screening procedure.[76] The results indicate that the HC levels detected by an unheated FID were much lower than the levels determined by the Level I screening procedure.

Based on cursor discussions in October of 1988 with several hazardous waste incinerator operators, we had believed that such heated systems were in use at some facili-

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[74] Report of the Products of Incomplete Combustion Subcommittee, Science Advisory Board, U.S. EPA, "Review of the Office of Solid Waste Proposed Controls for Hazardous Waste Incinerators: Products of Incomplete Combustion", October 24, 1989.

[75] U.S. EPA, "Measurement of Particulates, Metals, and Organics at a Hazardous Waste Incinerator", November, 1988, (Draft Final Report). NTIS order number: PB 89-230668.

[76] The Level of Screening procedure is described in *IERL-RTP Procedure Manual: Level I—Environmental Assessment*, 2nd Edition, October 1978 (EPA 600/7-78-201). That procedure uses gravimetric and total chromatographical organic procedures to quantify the mass of semi and nonvolatile organic compounds.

ties. A follow-up written survey[77] indicated, however, that all of the six incinerator facilities surveyed that use a FID to monitor HC used a system that incorporated gas conditioning—condensate traps accompanying gas cooling systems. Thus, the Agency has not been able to document operating experiences with a heated (i.e., not conditioned) gas sampling system. Further, we understand that, based on EPA tests using a heated FID at an incinerator (see footnote 66) and comments made during the SAB review of the PIC controls, a heated FID system can pose a number of problems: (1) the sample extraction lines may plug due to heavy particulate loadings and condensate organic compounds; and (2) semi and nonvolatile compounds may absorb on the inside of the extraction lines causing unknown effects on measurements.

Given these concerns about the technical feasibility of requiring the use of heated FIDs at this time, we are proposing that gas conditioning be allowed. Such conditioning could involve gas cooling at the condensate trap to a level between 40 and 64 °F to reduce the moisture content of the sample gas entering the FID to less than 2 percent. To reduce operation and maintenance problems, the sampling lines and FID should probably still be heated. The sample gas cannot, however, be "bubbled" through a water column because this could remove water-soluble hydrocarbons. We specifically request comments on performance specifications for gas conditioning systems.

Allowing gas conditioning in the interim until unconditioned systems can be shown to be practicable virtually precludes the use of the health-based alternative to assess HC emissions under the Tier II controls. This is because a large, undetermined fraction of hydrocarbon emissions will be condensed to the trap and will not be reported by

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[77] U.S. EPA, "THC Monitor Survey", June, 1989 (Draft Final Report).

the FID. This is another reason that the Agency prefers the technology-based, 20 ppmv limit on hydrocarbons as the Tier II standard.

Although a FID system monitoring a conditioned gas will detect only the volatile fraction of organic compounds,[78] the Agency believes this is adequate for the purpose of determining whether the facility is operating under good operating conditions.[79] Available data indicate that when emissions of semi and nonvalatile organic compounds increase, volatile compounds also increase.[80] Thus, volatile compounds appear to be a good indicator for the semi and nonvolatile compounds that are often of greater concern because of their health effects. Given, however, that the good operating practice-based hydrocarbon limit of 20 ppmv was based primarily on test burn data using heated (i.e., unconditioned gas) FID systems,[81] the Agency considered whether to lower the recommended hydrocarbon limit when an unheated system is used for compliance monitoring. As discussed above, limited avail-

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[78] We also note that some of the water-soluble hydrocarbons may also be removed by the gas conditioning system.

[79] We request comment on whether it would be practicable to develop a site-specific correction factor for monitoring with a conditioned gas system by monitoring with an unconditioned system as well during the trial burn. The ratio of the unconditioned system THC level to the conditioned system THC level could then be used to correct the conditioned system THC values over the life of the permit. This approach may not be practicable, however, for reasons including the fact that the waste burned during the trial burn for some facilities (e.g., facilities handling multiple wastes) may not represent, with respect to THC emissions, the waste that will be burned over the life of the permit.

[80] U.S. EPA, *Measurement of Particulates, Metals, and Organics at a Hazardous Waste Incinerator*, November, 1988 (Draft Final Report). NTIS Order No. PB89-230668.

[81] Heated systems were often used during trial burns with acceptable results given the short duration of the tests and the test personnel available to handle operational-problems.

able field test data indicated that a heated system would detect two to four times the mass of organic compounds than a conditioned system. We believe, however, that the 20 ppmv hydrocarbon limit is still appropriate when a conditioned system is used because: (1) the data correlating heated vs conditioned systems are very limited; (2) the data on HC emissions are limited (and there apparently is confusion in some cases as to whether the data were taken with a heated or conditioned system); and (3) the risk methodology is not sophisticated enough to demonstrate that a HC limit of 5 or 10 ppmv using a conditioned system rather than a limit 20 ppmv is needed to adequately protect public health.

The HC monitoring method proposed in appendix D of the boiler/furnace supplemental notice (54 FR 43743) will be modified to allow an unheated, conditioned system and use of condensate trap(s) and other conditioning methods. Performance specifications for the gas conditioning system would be discussed above.

5. *Compliance with Tier I CO Limit.* There are a number of alternative approaches to evaluate CO readings during the trial burn to determine compliance with the 100 ppmv limit including: (1) the time-weighted average CO level (or the average of the hourly rolling averages); (2) the average of the highest hourly rolling averages for all trial burn runs; or (3) the highest hourly rolling average. The time-weighted average alternative provides the lowest CO level that could reasonably be used to determine compliance, and the highest hourly rolling average alternative provides the highest CO level that could reasonably be used. There may be other reasonable alternatives between these two extremes in addition to the one listed above.

We are proposing to use the most conservative approach to interpret trial burn CO emissions for compliance with the 100 ppmv Tier 1 limit—the highest hourly rolling average. (This approach is conservative because

we are comparing the trial burn CO level to the maximum CO allowed under Tier I—100 ppmv.) We believe this conservative approach is reasonable given that compliance with Tier I allows the applicant to avoid the Tier II requirement to evaluate HC emissions to provide the additional assurance (or confirmation) that HC emissions do not exceed levels representative of good operating practice.

6. *Establishing Permit Limits for CO under Tier II.* The alternatives discussed above for interpreting CO trial burn data also apply to specifying the permit limit for CO under Tier II. For purposes of specifying a Tier II CO limit, however, the time-weighted average approach would be more conservative than the highest hourly average approach because it would result in a lower CO limit. We are proposing the conservative, time-weighted average approach for Tier II compliance because we are concerned that the highest hourly average approach may not be adequately protective. Although the highest hourly average (HHA) approach would be protective in theory because the applicant must demonstrate that the highest hourly average HC emissions do not exceed good operating practice-based levels, the HHA approach would allow the facility to operate continuously over the life of the permit at the highest CO levels that occurred during one hour of the trial burn.

We specifically request comments on how to interpret trial burn CO data to establish Tier II CO limits.

7. *Compliance with HC Limit of 20 ppmv.* The alternative approaches for determining compliance with the 20 ppmv HC limit under Tier II are identical to those discussed above for compliance with the Tier I CO limit. Again, we are proposing the most conservative approach —the highest hourly rolling average HC level during the (at a minimum) three test burns must not exceed 20 ppmv.

8. *Waste Feed Cutoff Requirements.* Today's proposal would require cutoff of the waste feed if the CO limit is exceeded. In addition, we are requesting comment on requiring continuous monitoring of HC. If continuous monitoring of HC is required, cut off of the waste feed would also be required if the HC limit is exceeded.

The regulations proposed today require that minimum permitted combustion temperatures be maintained after waste feed cutoff for the duration that the wastes remain in the combustion chamber. To comply with this requirement, the permit must specify the minimum combustion chamber temperature occurring during the trial burn for devices that may leave a waste residue in the combustion chamber after waste feed cutoff (e.g., devices burning wastes that are solids). We believe that PIC emissions from "smoldering" waste remaining in the combustion chamber should not pose unacceptable health risks provided that system temperatures are maintained.

An uninterruptible auxiliary burner of adequate capacity may be needed to maintain the temperature in the combustion chamber(s) and allow destruction of the waste materials and associated combustion gases left in the incineration system after the waste feed is cutoff due to an upset. The safe startup of the burners using auxiliary fuel require approved burner safety management systems for prepurge, postpurge, pilot lights and induced draft fan starts. If these safety requirements preclude immediate start-up of auxiliary fuel burners and such start-up is needed to maintain temperatures (i.e., if the combustion chamber temperatures drop precipitously after waste feed is cut-off), the auxiliary fuel may have to be burned continuously on low fire during non-upset conditions. After cutoff, hazardous waste may not be used as auxiliary fuel unless the waste is exempt under existing § 264.340(b) or (c) from the emissions standards because the waste is ignitable, corrosive, or reactive and contains insignificant levels of toxic constituents.

There is some concern that this requirement to maintain temperature in the combusion chamber after a waste feed cutoff may not be feasible in all cases (e.g., where the burner cannot be maintained in close proximity to the combustible vapor generation point because of an explosion hazard). EPA specifically requests comments on this issue, and what alternate approach should be used to reduce the possibility of PIC emissions from waste remaining in the chamber after a waste feed cutoff.

We request comment on several alternative approaches to allow restart of the waste feed: (1) restart after the hourly rolling average no longer exceeds the permit limit; (2) restart after an arbitrary 10 minute time period to enable the operator to stabilize combustion conditions; or (3) restart after the *instantaneous* CO level meets the hourly rolling average limit. This third alternative (i.e., basing restarts on the instantaneous CO levels) may be appropriate because it may take quite a while for the hourly rolling average to come within the permit limit while the event that caused the exceedance may well be over even before the CO monitor reports the exceedance. Under this alternative, the rolling average could be "reset" when the hazardous waste feed is restarted either by: (1) basing the hourly rolling average on the CO level for the first minute after the restart (the same approach that would be used any time the waste feed is restarted for reasons other than a CO exceedance); or (2) assuming more conservatively given that CO levels may exceed the permit limit after the waste feed cutoff while residues continue to burn, that the hourly rolling average is equivalent to the permit limit (e.g., 100 ppmv) prior to the waste feed restart. A final refinement to this third alternative of allowing restarts after instantaneous CO levels fali below the permit limit would be not to reset the rolling average CO level and to require that the instantaneous CO level not exceed the (rolling average) permit limit (e.g., 100 ppmv) for thc period after the restart and until the rolling average falls below the permit limit.

Again, we specifically request comment on these alternative approaches to allow waste feed restarts.

When the automatic waste feed cutoff is triggered by a HC exceedance (i.e., if the final rule limits HC levels beyond the trial burn and requires continuous HC monitoring), we propose to allow a restart only after the hourly rolling average HC level has been reduced to 20 ppmv or less. We are not considering the options discussed above for restarts after a CO exceedance given that HC is a better surrogate for toxic organic emissions than CO. Thus, we believe that a more conservative waste feed restart policy is appropriate after a HC exceedance.

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## APPENDIX E

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 261, 264, 265, 266, 270, and 271

[FRL-3358-5 EPA/OSW-FR-89-024]

RIN 2050-AA72

Burning of Hazardous Waste in Boilers and Industrial Furnaces

AGENCY: Environmental Protection Agency.

ACTION: Supplement to proposed rule.

SUMMARY: On May 6, 1987 (52 FR 16982), EPA proposed rules to control the burning of hazardous waste in boilers and industrial furnaces. Those rules would control emissions of products of incomplete combustion (PICs), toxic metals, and hydrogen chloride (HCl) as well as require a 99.99% destruction and removal efficiency for hazardous organic constituents in the waste. EPA has received substantial comments on the proposed rules, and as a result, is considering alternative approaches to several provisions of the proposed rule. The Agency is also considering issuance of a proposal to amend the hazardous waste incinerator standards to make those rules consistent with these proposed standards.

The purpose of this notice is to request comment on alternate approaches to address the following issues: control of CO, metals, HCl, and particulate emissions, the small quantity burner exemption, the definition of waste that is indigenous when burned for reclamation (e.g., of metal values), revisions to the proposed definition of halogen acid furnaces, applicability of the metals and organic emissions controls to smelting furnaces involved in materials recovery, and the status under the Bevill amendment of residues from burning hazardous waste.

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## II. Alternative PIC Controls

The 1987 proposed boiler and industrial furnace rule would limit flue gas carbon monoxide (CO) levels to ensure that these devices do not emit products of incomplete combustion (PICs) at levels that could pose unacceptable health risk. The Agency discusses here its revised thinkings on how best to establish controls on PIC emissions and we are also considering a proposal, which may be noticed shortly, to apply the revised approach to control PIC emissions from hazardous waste incinerators as well. We discuss below the comments received on the proposed rule and describe the revised approach.

### *A. Comments on Proposed CO Standard*

The proposed boiler and industrial furnace rule would have applied the same CO emissions limits to all boilers and industrial furnaces: a lower limit of 100 ppmv over a 60-minute rolling average and a 500 ppmv limit over a 10-minute rolling average. The hazardous waste feed would be automatically cut off if either limit was exceeded, and hazardous waste burning operations would have to cease pending review by enforcement officials if the waste feed were cut off more than 10 times a month. The lower limit of 100 ppmv was selected as representative of steady-state high efficiency combustion conditions resulting in PIC emissions that would not pose a significant risk. The higher limit of 500 ppmv was proposed to limit the frequency of emission spikes that inevitably accompany routine operational transients, such as load changes and start-up of waste firing.

Many commenters opposed the proposed CO trigger limits and associated limits on the number of waste feed cutoffs. Principally, commenters objected to one set of CO emission limits applicable to all boilers and industrial furnaces. Further, they argued that PIC emissions would not be significant if, when the waste feed was cut off, combustion chamber temperatures were maintained while

the waste remained in the chamber. Thus, they argued that there was no need to limit the number of waste feed cutoffs.

Commenters indicated that several types of boilers and many cement kilns would not be able to meet the proposed 100 ppmv limit even though hydrocarbon concentrations would not be high at the elevated CO levels. For example, boilers burning residual oil or coal typically operate with CO emission levels above the proposed 100 ppmv limit because of inherent fuel combustion characteristics, equipment design constraints, routine transient combustion-related events, requirements for multiple fuel flexibility, and compliance with $NO_x$ emission standards. Attempts to reduce CO emissions from these devices to meet the proposed limits may prove unsuccessful in addition to the possibility of heavy penalties in thermal efficiency if successful.

Similarly, industry and trade groups for the cement industry voiced strong opposition to the 100 ppmv limit for cement kilns. These commenters indicated that some cement kilns, especially modern precalciners, routinely emit CO above the proposed 100 ppmv limit. In general commenters indicated that while the proposed limits may be appropriate for combustion devices in which only fuel (fossils or hazardous waste) enters the combustion chamber, they are inappropriate for cement kilns and other product kilns in which massive amounts of feedstocks are processed. These feedstocks can generate large quantities of CO emissions which are, in large part, unrelated to the combustion efficiency of burning the waste and fuel. Whereas all the CO from boilers and some industrial furnaces is combustion-generated, the bulk of the CO from product kilns can be the result of process events unrelated to the combustion conditions at the burner where wastes are introduced.[2] Therefore, limiting CO

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[2] For example, CO can be generated from the trace levels of organic matter contained in the raw materials as the materials move

emissions from these combustion devices to the proposed 100 ppmv level may be difficult and not warranted as a means of minimizing risk from PICs.

In summary, commenters argued that the proposed CO limits would be difficult or virtually impossible to meet in some cases, and, thus, inappropriate given that EPA has not established a direct correlation between CO, PIC emissions, and health risk.

In light of these concerns, commenters suggested that EPA establish CO limits for specific categories of devices based on CO levels achieved by units operating under best operating practices (BOP). We considered this approach but determined that equipment-specific CO trigger limits would be difficult to establish and support and would not necessarily provide adequate protection from PIC emissions. For example, the BOP CO level for a precalcining cement kiln may be 800 ppmv, a level that industry representatives indicate may be typical in some situations for that device. If that CO level, in fact, results in part from the inefficient combustion of hazardous waste, PICs may be emitted at levels that pose significant risk. (We note, however, that PIC emissions may or may not be high when CO levels are high. However, in all known instances, PIC emissions are low when CO levels are under 100 ppmv.)

EPA nonetheless believes that the CO limits should be flexible to avoid major economic impacts on the regulated community given that we cannot say that when CO levels exceed 100 ppmv that PIC emissions will always, or even often, result in significant health risk. At some elevated

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down the kiln from the cold end to the hot end where the fuel and waste is fired. CO can also be generated by combustion of fossil fuel at the base of the precalciner, which takes combustion gases from the kiln and heats them further with fossil fuel to precalcine the raw materials before feeding into the kiln. Although hazardous waste may not be fired in a precalciner, inefficient combustion of the precalciner fuel will result in high flue gas CO levels.

CO level, however, PIC emissions would pose significant risk. Unfortunately, we cannot at this time identify the precise trigger level—the trigger level may vary by type and design of device and fuel mix. Consequently, we have developed a two-tiered approach to control PICs. Under Tier I, CO would be limited to the 100 ppmv limit proposed in 1987. (See appendix A for background information on the basis for the Agency's concern about PIC emissions and the use of CO to minimize the potential health risk.) Under Tier II, the 100 ppmv CO limit would be waived under two alternative approaches: (1) a demonstration that total hydrocarbon (THC) emissions are not likely to pose unacceptable health risk using conservative, prescribed risk assessment procedures; or (2) a demonstration that the THC concentration in the stack gas does not exceed a good operating practice-based limit of 20 ppmv. Although we prefer the technology-based approach for reasons discussed below, we request comment on the health-based alternative as well.

*B. Proposed Tier II Controls*

If the highest hourly average CO level during the trial burn exceeds the Tier I limit of 100 ppmv, a higher CO level would be allowed under two alternative approaches: a health-based approach, or a technology-based approach.[3] We prefer the technology-based approach for reasons discussed below. One of the alternatives will be selected for the final rule based on public comment and Agency eval-

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[3] This two-tiered approach would supersede the approach proposed in 1987 whereby the waste feed would be cutoff within 10 minutes of exceeding a 100 ppmv hourly rolling average CO level and immediately when exceeding a 500 ppmv rolling 10 minute average. We believe that the approach proposed in today's notice is more environmentally conservative and supportable in light of commenters' concerns about the technical support for the dual range CO limits and averaging periods proposed in 1987.

uation, including a critique by the Agency's Science Advisory Board (SAB).[4]

1. *Health-Based Approach.* Under the health-based approach to waive the 100 ppmv CO limit, the applicant would be allowed to demonstrate that PIC emissions from the combustion device pose an acceptable risk (i.e., less than $10^{-5}$) to the maximum exposed individual (MEI). Under this approach we would require the applicant to quantify total hydrocarbon (THC) emissions during the trial burn and to assume that all hydrocarbons are carcinogenic compounds with a unit risk that has been calculated based on available data. The THC unit risk value would be $1.0 \times 10^{-5} m^3/\mu g$ and represents the adjusted, 95th percentile weighted (i.e., by emission concentration) average unit risk of all the hydrocarbon emissions data in our data base of field testing of boilers, industrial furnaces, and incinerators burning hazardous waste. The weighted unit risk value for THC considers emissions data for carcinogenic PICs (e.g., chlorinated dioxins and furans, benzene, chloroform, carbon tetrachloride) as well as data for PICs that are not suspected carcinogens and are considered to be relatively nontoxic (e.g., methane, and other $C_1$ as well as $C_2$ pure hydrocarbons, i.e., containing only carbon and hydrogen). We adjusted the data base as follows to increase the conservation of the calculated THC unit risk value: (1) We assumed that the carcinogen formaldehyde is emitted from hazardous waste combustion devices at the 95th percentile levels found to be emited from municipal waste combustors;[5] and (2) we assumed that every carcinogenic compound in Appendix VIII of Part 261 for which we

[4] EPA's SAB reviewed the proposed PIC controls in the spring of 1989 and a final report is scheduled to be available in the fall of 1989.

[5] Because of its extremely high violatility, special stack sampling and analysis procedures are required to measure formaldehyde emissions. Such testing has not been successfully conducted during EPA's field testing of hazardous waste combustion devices.

have health effects data but no emissions data is actually emitted at the level of detection of the test methods, 0.1 ng/l. Finally, we assigned a unit risk of zero to non-carcinogenic compounds (e.g., $C_1$-$C_2$ hydrocarbons such as methane, acetylene). The calculated unit risk value for THC is $1 \times 10^{-5} m^3/\mu g$, comparable to the value for carbon tetrachloride.[6]

To implement the health-based approach with minimum burden on permit writers and applicants, we have established conservative THC emission Screening Limits as a function of effective stack height, terrain, and land use. See appendix B. These Screening Limits were back-calculated from the acceptable ambient level for THC, 1.0 $\mu g/m^3$ (based on the unit risk value discussed above and an acceptable MEI risk of $10^{-5}$), using conservative dispersion coefficients. (We also used those dispersions coefficients to develop alternative emissions and feed rate limits for metals and HC1, as discussed below. The basis for those dispersion coefficients is also discussed below.) If THC emissions measured during the trial burn do not exceed the THC emissions Screening Limits, the risk posed by THC emissions would be considered acceptable. If the Screening Limits are exceeded, the applicant would be required to conduct site-specific dispersion modeling using EPA's "Guidelines on Air Quality Models (Revised)" to demonstrate that the (potential) MEI exposure level (i.e., the maximum annual average ground level concentration) does not exceed the acceptable THC ambient level.

2. *Technology-Based Approach.* Under this Tier II approach, the Tier I CO limit of 100 ppmv would be waived if THC levels in the stack gas do not exceed a good operating practice-based limit of 20 ppmv.

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[6] For additional technical support, see U.S. EPA, "Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators," December, 1988 (Draft Final Report).

We have developed this technology-based approach because of concern about scientific limitations of the risk-based approach. In addition, the risk-based approach could allow THC levels of several hundred ppmv—levels that are clearly indicative of upset combustion conditions.

The Agency believes that risk assessment can and should be used to limit the application of technology-based controls—that is, to demonstrate that additional technology controls, even though available, may not be needed. However, we are sufficiently concerned that our proposed THC risk assessment methodology may have limitations particularly when applied to THC emitted during poor combustion conditions (i.e., situations where CO exceeds 100 ppmv) that we are considering a cap on THC emissions. Although we believe the development of a risk-based approach is a step in the right direction, we are concerned whether the risk-based approach is adequately protective given our limited data base on PIC emissions and understanding of what fraction of organic emissions would be detected by the THC monitoring system. Notwithstanding the limitations of the THC risk assessment methodology, however, we believe it is reasonable to use the methodology to predict whether a technology-based limit appears to be protective. We have used the risk assessment methodology to show that a 20 ppmv THC limit appears to be protective of public health.

We discuss below our concerns with the proposed THC risk-based approach and the basis for tentatively selecting 20 ppmv as the recommended THC limit (measured with a conditioned gas monitoring system, recorded on an hourly rolling average basis, reported as propane, and corrected to 7% oxygen).

a. *Concerns with the THC Risk Assessment Methodology.* Our primary concern with the risk assessment methodology is that, although it may be a reasonable approach for evaluating PIC emissions under good combustion conditions, it may not be adequate for poor com-

bustion conditions—when CO exceeds 100 ppmv. The vast majority of our data on the types and concentrations of PIC emissions from incinerators, boilers, and industrial furnaces burning hazardous waste were obtained during test burns when the devices were operated under good combustion conditions. CO levels were often well below 50 ppmv. Under Tier II applications, CO levels can be 500 to 10,000 ppmv or higher (there is no upper limit on CO).[7] The concern is that we do not know whether the types and concentrations of PICs at these elevated CO levels, indicative of combustion upset conditions, are similar to the types and concentrations of PICs in our data base. It could be hypothesized that as combustion conditions deteriorate, the ratio of semi- and nonvolatile compounds to volatile compounds may increase. If so, this could have serious impacts on the proposed risk assessment methodology. First, the proposed generic unit risk value for THC may be understated when applied to THC emitted under poor combustion conditions. This is because semi- and nonvolatile compounds comprise only 1% of the mass of THC in our data base, but pose 80% of the estimated cancer risk. Thus, if the fraction of semi- and nonvolatile compounds increases under poor combustion conditions, the cancer risk posed by the compounds may also increase.

To put this concern in perspective, we note that the proposed THC risk value calculated from available data is $1 \times 10^{-6}{}_{m}{}^{3}/\mu g$. This unit risk is 100 times greater (i.e., more potent) than the unit risk for the quantified PICs with the lowest unit risk (e.g., tetrachloroethylene), but 1000 times lower than the unit risk for PICs such as dibenzoanthracene, and 10,000 to 1,000,000 times lower than the unit risk for various chlorinated dioxins and furans.

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[7] Hazardous waste incinerators have operated at CO levels exceeding 13,000 ppmv during trial burns that achieved 99.99% distribution and removal efficiency.

Second, if the fraction of semi- and nonvolatile THC increases under poor combustion conditions, the fraction of THC in the vapor phase when entering the THC detector may be lower than the 75% assumed when operating under good combustion conditions.[8] If so, the correction factor for the so-called missing mass would be greater than the 1.33 factor proposed.

The Agency is currently conducting emissions testing to improve the data base in support of the proposed risk-based approach. We are concerned, however, that the testing that is underway and planned may not provide information adequate to fully address all the issues. In addition, we are concerned that our stack sampling and analysis procedures and our health effects data base are not adequate to satisfactorily characterize the health effects posed by Pics emitted under poor combustion conditions.

A final concern with the risk assessment methodology is that it does not consider health impacts resulting from indirect exposure. As explained above, the risk-based standards proposed today consider human health impacts only from direct inhalation. Indirect exposure via uptake through the food chain, for example, has not been considered because the Agency has not yet developed procedures for quantifying indirect exposure impacts for purposes of establishing regulatory emission limits.

b. *Basis for the THC Limit.* We request comment on a THC limit of 20 ppmv as representative of a THC level distinguishing between good and poor combustion conditions. Under this alternative approach, THC would be monitored continuously during the trial burn, recorded on an hourly average basis, reported as ppmv propane, and corrected to 7% oxygen. (See discussion below in

[8] See discussions in U.S. EPA, "Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators", December, 1988 (Draft Final Report).

section C.4 regarding performance specifications of the THC monitoring system.) We have tentatively selected a level of 20 ppmv because: (1) It is within the range of values reported in our data base for hazardous waste incinerators and boilers and industrial furnaces burning hazardous waste; and (2) the level appears to be protective of human health based on risk assessments using the proposed methodology for 30 incinerators.[9]

The available data appear to indicate that the majority of devices can meet a THC limit of 20 ppmv when operating under good combustion conditions (i.e., when CO is less than 100 ppmv). It appears, in fact, that many hazardous waste incinerators can typically achieve THC levels of 5 to 10 ppmv when operating generally at low CO levels. When incinerators emit higher THC levels, CO levels typically exceed 100 ppmv, indicative of poor combustion conditions. The available information on boilers and industrial furnaces is not quite as clear, however. Although the data base indicates that boilers burning hazardous waste can easily meet a THC limit of 20 ppmv, the Agency has obtained data on various types of boilers burning various types of fossil fuels (not hazardous waste) that indicate that THC levels can exceed 20 ppmv when CO levels are less than 100 ppmv. See footnote 7. We are reviewing that data and obtaining additional information to determine if an alternative limit may be more appropriate for boilers. We specifically request comment on whether a THC concentration of 20 ppmv in fact represents good operating practice for boilers burning hazardous waste as the sole fuel or in combination with other fuels.

We also request comment on whether a THC concentration of 20 ppmv represents good operating practice for industrial furnaces. Preheater and precalciner cement

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[9] Memorandum from Shiva Garg, EPA, to the Docket, entitled "Supporting Information for a GOP-Based THC Limit", dated October 20, 1988.

kilns, for example, may not be able to readily achieve such a low THC concentration for the same reason that they typically cannot achieve CO levels below 100 ppmv. Normal raw materials such as limestone can contain trace levels of organic materials that oxidize incompletely as the raw material moves down the kiln from the feed end to the hot end where fuels are normally fired. Clearly, any THC (or CO) resulting from this phenomenon has nothing to do with combustion or hazardous waste fuel. Thus, an incinerator and a preheater or precalciner cement kiln with exactly the same quality of combustion conditions may have very different THC (and CO) levels. We request comment on: (1) The types of industrial furnaces for which a THC level of 20 ppmv is representative of good combustion conditions; (2) whether alternative THC limits may be more appropriate for certain industrial furnaces; and (3) whether an approach to identify a site-specific THC limit representative of good operating practices may be feasible (e.g., where THC levels when burning hazardous waste would be limited to baseline THC levels without burning hazardous waste). In support of comments, we request data on emissions of CO and THC under baseline and hazardous waste burning conditions, including characterization of the type and concentration of individual organic compounds emitted.

As mentioned previously, some data on CO and THC levels from industrial boilers burning fossil fuels (not hazardous waste) appear to indicate that THC levels can far exceed levels considered to be representative of good combustion conditions (20 ppmv) even though CO levels are less than 100 ppmv. See footnote 7. If it appears that this situation can, in fact, occur for particular devices burning particular fuels, we would consider requiring both CO and THC monitoring for all such facilities irrespective of whether CO levels were less than 100 ppmv during the trial burn. Thus, under this scenario, the two-tiered CO controls proposed today would be replaced with a requirement to continuously monitor CO

and THC for those particular facilities. We specifically request information on the types of facilities where THC levels may exceed 20 ppmv even though CO levels are less than 100 ppmv, and the need to continuously monitor THC for those facilities irrespective of the CO level achieved during the trial burn.

*C. Implementation of Tier I and Tier II PIC Controls*

1. *Oxygen and Moisture Correction.* The CO limits specified for either format are on a dry gas basis and corrected to 7 percent oxygen. The oxygen correction normalizes the CO data to a common base, recognizing the variation among the different technologies as well as modes of operation using different quantities of excess air. In-system leakage, the size of the facility and the type of waste feed are other factors that cause oxygen concentration to vary widely in flue gases. Seven percent oxygen was selected as the reference oxygen because it is in the middle of the range of normal oxygen levels for hazardous waste combustion devices and it also is the reference level for the existing particulate standard for hazardous waste incinerators under § 264.343(c). The correction for humidity normalizes the CO data from the different types of CO monitors (e.g., extractive vs. in situ). Our evaluation indicates that the above two corrections, when applied, could change the measured CO levels by a factor of two in some cases.

Measured CO levels should be corrected continuously for the amount of oxygen in the stack gas according to the formula:

$$CO_c = CO_m \times \frac{14}{21 - Y}$$

where $CO_c$ is this corrected concentration of CO in the stack gas, $CO_m$ is the measured CO concentration according to guidelines specified in appendix C, and Y is the measured oxygen concentration on a dry basis in the

stack. Oxygen should be measured at the same stack location that CO is measured.

2. *Formats of the CO Limit.* The CO limits under Tier I and Tier II would be implemented under two alternative formats. The applicant would select the preferred approach on a case-by-case basis. Under Format A, CO would be measured and recorded as an hourly rolling average. Under Format B, called the time-above-a-limit format, three parameters would be specified —a never-to-exceed CO limit, and a base CO limit not to be exceeded for more than a specified time in each hour.

In developing these alternative formats, EPA considered three alternative methods:

- A level never to be exceeded;
- A level to be exceeded for an accumlated specified time within a determined time frame; and
- An average level over a specified time that is never to be exceeded.

The first alternative is the simplest and requires immediate hazardous waste feed cutoff when the limit is exceeded, regardless of how long the CO levels remain high. Short-term CO excursions or peaks (a few minutes duration) are typical of combustion operations and can occur during routine operations; e.g., when a burner is adjusted. It is possible that during shutdown and start-up, the device may momentarily have high CO emissions. Since the total mass emissions under such momentary CO excursions is not high, a never-to-exceed limit would impede operations while providing little reduction in health risk.

The second alternative allowing the CO level to exceed the limit for a specified accumulative time within a determined time frame (e.g., x minutes in an hour), solves the problem associated with the first alternative. The

hazardous waste feed would not be cut off by a single CO peak of high intensity yet they would be restricted from operation with several short interval CO peaks, or a single long duration peak.

The third alternative, allowing the CO level never to exceed an average level determined over a specified time, also avoids the problem of shutting off the waste feed each time an instantaneous CO peak occurs. A time-weighted average value (i.e., integrated area under the CO peaks over a given time period) also provides a direct quantitative measure of mass emissions of CO. For this reason, the use of a rolling average is EPA's preferred format. A combination of the first and second alternatives, with provisions to limit mass CO emissions per unit time, its also proposed as an alternative format. This alternative CO format has been proposed to reduce the cost of instrumentation from that required to provide continuous rolling average CO values corrected for oxygen. This format may be particularly attractive to operators of small or intermittently operated boilers. The CO monitoring system needed for the first alternative requires continuous measurement and adjustment of the oxygen correction factor and continuous computation of hourly rolling averages. The instrumentation costs of such a system, consisting of continuous CO and oxygen monitors with back-up systems, a data logger and microprocessor, could be up to $91,000 and would require increased sophistication and operating costs over simpler systems. The only instrumentation needed for the alternative time-above-the-limit format is a CO monitor and a timer that can indicate cumulative time of exceedances in every clock hour, at the end of which it is recalibrated (manually or electronically) to restart afresh. Oxygen also would not have to be measured continuously in this format; instead, an oxygen correction value can be determined from operating data collected during the trial burn. Subsequently, oxygen correction values would be determined annually or at more frequent intervals specified in

the facility permit.[10] We have not limited the use of this alternative CO format to any size or to any type or class of device since we consider that this alternative format provides an equal degree of control of CO emissions to the rolling average format.

The alternative format would require dual CO levels to be established in the permit, the first as a never to exceed limit and the second a lower limit for cumulative exceedances of no more than a specified time in an hour. These limits and the time duration of exceedance would be established on a case-by-case basis by equating the mass emissions (peak areas) in both the formats so that the regulation is equally stringent in both cases. The PIC Background Document [11] for the incinerator rules provides the methodology and mathematical formulae showing how this can be done.

3. *Monitoring CO and Oxygen.* Compliance with the Tier I CO limit would require: (1) Continuous monitoring of CO during the trial burn and after the facility is permitted; (2) continuous monitoring of oxygen during the trial burn and, under the 60-minute rolling average format, after the facility is permitted; and (3) measurement of moisture during the trial burn and annually (or as specified in the permit) thereafter. Compliance with the Tier II CO limits would require all the Tier I measurements and measurement of THC during the trial burn. Methods for measurements of CO and oxygen, (and THC) must be in accordance with the 3rd edition of SW-846, as amended.

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[10] We believe that annual determinations of the oxygen correction factor will be appropriate in most cases because the concern is whether duct in-leakage has substantially changed over time. The fact that excess oxygen levels also change with waste type and feed rate should be considered in establishing the correction factor initially.

[11] U.S. EPA, "Background Information Document for the Development of Regulations for PIC Emissions from Hazardous Waste Incinerators," December, 1988 (Draft Final Report).

The methods are summarized in Appendix C and are discussed in more detail in "Proposed Methods for Stack Emissions Measurements of CO, $O_2$, THC, HCl, and Metals at Hazardous Waste Incinerators", U.S. EPA, July, 1989 (Draft Final Report). If compliance with the CO standard is not demonstrated during the DRE trial burn, the CO test burn must be under conditions identical to the DRE trial burn.

4. *Monitoring THC.* Under Tier II, THC would be monitored during the trial burn to ensure that the highest hourly average level does not exceed 20 ppmv. An exceedance of the THC limit would be linked to automatic waste feed cutoff. We believe that continuous THC monitoring should also be required over the life of the permit. This is because at high CO levels (e.g., greater than 100 ppmv) THC levels may or may not be high (e.g., greater than 20 ppmv). The concern is that, although THC levels during the trial burn may be less than 20 ppmv when CO exceeds 100 ppmv, operations over the life of the permit within the envelope allowed by the permit conditions may result in THC levels exceeding 20 ppmv. This concern was expressed by EPA's Science Advisory Board during its critique of the proposed PIC controls in the spring of 1989. EPA specifically requests comments on whether continuous monitoring of THC should be required over the life of the permit under Tier II.

EPA had developed specifications for THC monitoring (see appendix D) that would have required heated gas sampling lines and a heated flame ionization detector (FID) to keep as much of the THC in the vapor phase as possible. EPA reasoned that heated sampling lines were needed because the FID can detect THC only in the vapor phase—condensed organic compounds are not measured. Preliminary results of field testing of a hazardous waste incinerator conducted in July 1988 indicate that detected THC levels were 3 to 27 times greater with a heated FID system compared to an unheated system when CO levels

ranged from 100 ppmv to 2760 ppmv.[12] The total mass of volatile, semivolatile, and nonvolatile organic compounds was also quantified during those tests using the Level I screening procedure.[13] The results indicate that the THC levels detected by an unheated FID were much lower than the levels determind by the Level I screening procedure.

Based on cursory discussions in October of 1988 with several hazardous waste incinerator operators, we had believed that such heated systems were in use at some facilities. A follow-up written survey [14] indicated, however, that all of the six incinerator facilities surveyed that use a FID to monitor THC used a system that incorporated gas conditioning—condensate traps accompanying gas cooling systems. Thus, the Agency has not been able to document operating experiences with a heated (i.e., not conditioned) gas sampling system. Further, we understand that, based on EPA tests using a heated FID at an incinerator (see footnote 11) and comments made during the SAB review of the PIC controls, a heated FID system can pose a number of problems: (1) The sample extraction lines may plug due to heavy particulate loadings and condensed organic compounds; and (2) semi and nonvolatile compounds may adsorb on the inside of the extraction lines causing unknown effects on measurements.

Given these concerns about the technical feasibility of requiring the use of heated FIDs at this time, we are proposing that gas conditioning be allowed. Such condition-

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[12] U.S. EPA, "Measurement of Particulates, Metals, and Organics at a Hazardous Waste Incinerator", November, 1988, (Draft Final Report).

[13] The Level I screening procedure is described in "IERL-RTP Procedure Manual: Level I—Environmental Assessment," 2nd Edition, October 1978 (EPA 600/7-78-201). That procedure uses gravimetric and total chromatographical organic procedures to quantify the mass of semi and nonvolatile organic compounds.

[14] U.S. EPA, "THC Monitor Survey", June, 1989 (Draft Final Report).

ing could involve gas cooling to a level between 32 °F and the dew point of the gas and the use of condensate traps. To reduce operation and maintenance problems, the extraction lines and FID should probably still be heated.

Allowing gas conditioning in the interim until unconditioned systems can be shown to be practicable virtually precludes the use of the health-based alternative to assess THC emissions under the Tier II controls. This is because a large, undetermined fraction of THC emissions will be condensed to the trap and will not be reported by the FID. This is another reason that the Agency prefers the technology-based, 20 ppmv limit on THC as the Tier II standard.

Although a FID system monitoring a conditioned gas will detect only the volatile fraction of organic compounds (and, in some cases, only the nonwater-soluble volatile fraction), the Agency believes this is adequate for the purpose of determining whether the facility is operating under good operating conditions.[15] Available data indicate that when emissions of semi and nonvolatile organic compounds increase, volatile compounds also increase.[16] Thus, volatile compounds appear to be a good indicator for the semi and nonvolatile compounds that are often of greater concern because of their health effects. Given, however,

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[15] We request comment on whether it would be practicable to develop a site-specific correction factor for monitoring with a conditioned gas system by monitoring with an unconditioned system as well during the trial burn. The ratio of the unconditioned system THC level to the conditioned system THC level could then be used to correct the conditioned system THC values over the life of the permit. This approach may not be practicable, however, for reasons including the fact that the waste burned during the trial burn for some facilities (e.g., facilities handling multiple wastes) may not represent, with respect to THC emissions, the waste that will be burned over the life of the permit.

[16] U.S. EPA, "Measurement of Particulates, Metals, and Organics at a Hazardous Waste Incinerator," November, 1988 (Draft Final Report).

that the good operating practice-based THC limit of 20 ppmv was based primarily on test burn data using heated (i.e., unconditioned gas) FID ssytems, the Agency considered whether to lower the recommended THC limit when an unheated system is used for compliance monitoring. As discussed above, limited available field test data indicated that a heated system would detect two to four times the mass of organic compounds than a conditioned system. We believe, however, that the 20 ppmv THC limit is still appropriate when a conditioned system is used because: (1) The data correlating heated vs conditioned systems are very limited; (2) the data on THC emissions are limited (and there apparently is confusion in some cases as to whether the data were taken with a heated or conditioned system); and (3) the risk methodology is not sophisticated enough to demonstrate that a THC limit of 5 to 10 ppmv using a conditioned system rather than a limit of 20 ppmv is needed to adequately protect public health.

The THC monitoring method proposed in Appendix D will be modified to allow an unheated, conditioned system and use of condensate trap(s) and other conditioning methods. The revised method will specify, however, that the sample gas may not be cooled below 32 °F.

5. *Compliance with Tier I CO Limit.* There are a number of alternative approaches to evaluate CO readings during the trial burn to determine compliance with the 100 ppmv limit including: (1) The time-weighted average CO level (or the average of the hourly rolling averages); (2) the average of the highests hourly rolling averages for all trial burn runs; of (3) the highest hourly rolling average. The time-weighted average alternative provides the lowest CO level that could reasonably be used to determine compliance, and the highest hourly rolling average alternative provides the highest CO level that could reasonably be used. There may be other reasonable alternatives between these two extremes in addition to the one listed above.

We are proposing to use the most conservative approach to interpret trial burn CO emissions for compliance with the 100 ppmv Tier I limit—the highest hourly rolling average. (This approach is conservative because we are comparing the trial burn CO level to the maximum CO allowed under Tier I—100 ppmv.) We believe this conservative approach is reasonable given that compliance with Tier I allows the applicant to avoid the Tier II requirement to evaluate THC emissions to provide the additional assurance (or confirmation) that THC emissions do not exceed levels representative of good operating practice.

6. *Establishing Permit Limits for CO under Tier II.* The alternatives discussed above for interpreting CO trial burn data also apply to specifying the permit limit for CO under Tier II. For purposes of specifying a Tier II CO limit, however, the time-weighted average approach would be more conservative than the highest hourly average approach because it would result in a lower CO limit. We are proposing the conservative, time-weighted average approach for Tier II compliance because we are concerned that the highest hourly average approach may not be adequately protective. Although the highest hourly average (HHA) approach would be protective in theory because the applicant must demonstrate that the highest hourly average THC emissions do not exceed good operating practice-based levels, the HHA approach would allow the facility to operate continuously over the life of the permit at the highest CO levels that occurred during one hour of the trial burn.

We specifically request comments on how to interpret trial burn CO data to establish Tier II CO limits.

7. *Compliance with THC Limit of 20 ppmv.* The alternative approaches for determining compliance with the 20 ppmv THC limit under Tier II are identical to those discussed above for compliance with the Tier I CO limit. Again, we are proposing the most conservative approach—

the highest hourly rolling average THC level during the (at a minimum) three test burns must not exceed 20 ppmv.

8. *Waste Feed Cutoffs.* In 1987, EPA proposed that if a device exceeded the CO limits an aggregate of 10 times per month, then the owner or operator must cease burning hazardous waste, notify the Regional Administrator, and not resume burning hazardous waste until reauthorized by the Regional Administration. Commenters complained that this proposed requirements was overly conservative. In response, EPA is considering deleting this restriction. We do not have data that indicate, nor are we aware of a good argument that would support, the need to limit cutoffs provided that combustion chamber temperatures are maintained at the levels that occurred during the trial burn for the duration of time that waste remains in the combustion chamber. We believe that maintaining temperatures will ensure that hydrocarbons emanating from the waste remaining in the combustion chamber after a cutoff are destroyed to levels that would pose acceptable health risk. To comply with this requirement, the permit must specify the minimum combustion chamber temperature occurring during the trial burn for devices that may leave a waste residue in the combustion chamber after waste feed cutoff (e.g., devices burning wastes that are solids). We note that, to comply with this requirement, owners and operators of boilers that comply with the proposed special operating conditions requisite to automatic waiver of the trial burn may be required to document minimum combustion chamber temperatures while complying with those special operating conditions. Moreover, we specifically request comment on the need to specify in the permit for all boilers and industrial furnaces, the minimum allowable combustion chamber temperatures based on the trial burn.

We note that adequate auxiliary burner capacity may be needed to maintain the temperature in the combustion chamber and allow destruction of the waste materials and associated combustion gases left in the system after the

waste feed is automatically cutoff. The safe start-up of the burners using auxiliary fuel requires approved burner safety management systems for prepurge, pilot lights, and induced draft fan starts. If these safety requirements preclude immediate startup of auxiliary fuel burners and such start-up is needed to maintain temperatures (i.e., if the combustion chamber temperatures drop precipitously after waste feed cutoff), the auxiliary fuel may have to be burned continuously on "low fire" during nonupset conditions. After an automatic cutoff, hazardous waste should not be used as auxiliary fuel unless the waste is hazardous solely because it is ignitable, corrosive, or reactive, or it contains insignificant levels of toxic constituents.

We request comment on several alternative approaches to allow restart of the waste feed: (1) Restart after the hourly rolling average no longer exceeds the permit limit; (2) restart after an arbitrary 10 minute time period to enable the operator to stabilize combustion conditions; or (3) restart after the *instantaneous* CO level meets the hourly rolling average limit. This third alternative (i.e., basing restarts on the instantaneous CO levels) may be appropriate because it may take quite a while for the hourly rolling average to come within the permit limit while the event that caused the exceedance may well be over even before the CO monitor reports the exceedance. Under this alternative, the rolling average could be "re-set" when the hazardous waste feed is restarted either by: (1) basing the hourly rolling average on the CO level for the first minute after the restart (the same approach that would be used any time the waste feed is restarted for reasons other than a CO exceedance); or (2) assuming more conservatively given that CO levels may exceed the permit limit after the waste feed cutoff while residues continue to burn, that the hourly rolling average is equivalent to the permit limit (e.g., 100 ppmv) prior to the waste feed restart. A final refinement to this third alternative of allowing restarts after instantaneous CO levels

fall below the permit limit would be not to reset the rolling average CO level and to require that the instantaneous CO level not exceed the (rolling average) permit limit (e.g., 100 ppmv) for the period after the restart and until the rolling average falls below the permit limit. Again, we specifically request comment on these alternative approaches to allow waste feed restarts.

When the automatic waste feed cutoff is triggered by a THC exceedance, we propose to allow a restart only after the hourly rolling average THC level has been reduced to 20 ppmv or less. We are not considering the options discussed above for restarts after a CO exceedance given that THC is a better surrogate for toxic organic emissions than CO. Thus, we believe that a more conservative waste feed restart policy is appropriate after a THC exceedance.

*D. Miscellaneous Issues*

1. *PIC Controls for Nonflame Industrial Furnaces.* We note that the PIC controls discussed above may not adequately control THC emissions from nonflame furnaces such as some electric arc smelters (in situations where, in fact, controls for emissions of organic compounds would apply (see discussion in section IX)). In nonflame devices where combustion is neither the primary mode of destruction of organic compounds in the waste, nor is used in an afterburner to burn hydrocarbon-laden off-gases from the thermal cracking of the waste, CO may not be an adequate surrogate to control THC emissions. That is, in nonflame devices, when CO emissions are low, THC emissions may be *high*. Thus, the Tier I CO limit of 100 ppmv may not be adequate to ensure that THC concentrations are low. Accordingly, we request comment on requiring continuous THC monitoring for nonflame devices to ensure that THC concentrations do not exceed the good operating practice-based level of 20 ppmv.

2. *Measuring CO and THC in Preheater and Precalciner Cement Kilns.* EPA has received comments that pre-

heater and precalciner cement kilns typically have bypass ducts that by-pass the preheater or precalciner and carry kiln off-gases directly to the stack. Measuring CO and THC in the bypass duct rather than in the stack would provide data unaffected by CO and THC produced in the preheater or precalciner by coal combustion (in the precalciner) or by volatilizing trace levels of organic compounds present in the raw material. Testing of bypass gases in lieu of stack gases would be acceptable for compliance with the CO and THC controls provided that the CO and THC levels in the bypass gases are representative of the kiln off-gases (i.e., provided that CO and THC in the kiln off-gases are not stratified before entering the bypass).

3. *Feeding Waste in Cement Kilns by Methods Other Than Dispersion in the Flame at the Hot End.* The Agency is aware that several cement companies are investigating the feasibility of feeding solid hazardous waste into cement kilns and some facilities are already engaging in the practice. The solid materials are fed into the kiln system at locations other than the "hot" end of the kiln where liquid hazardous waste fuels and fossil fuels are normally fired. These practices may be an effective approach to both beneficially use the heating value in solid hazardous wastes and provide needed treatment capacity for such wastes. The Agency has not, however, conducted emission testing of cement kiln systems when burning solid hazardous wastes. Depending on the kiln system, location of the firing port, and type and quantity of hazardous waste fired, there is a potential concern for incomplete combustion of organic compounds in the waste. Conceivably, the waste may be fired into the systems at a point where adequate temperatures and residence time may not be provided to ensure adequate destruction. In addition, if a kiln system is equipped with a by-pass duct, combustion gases from burning the hazardous waste may be "short-circuited" and routed to the stack before adequate destruction can occur.

The proposed controls will effectively control emissions irrespective of how solid hazardous waste may be fired into kiln systems because the standards would apply to stack emissions. The question is, given that the Agency has not yet tested such operations, whether special requirements should be applied during interim status. We specifically request comment on the need for special controls during interim status when cement kiln systems feed hazardous waste at locations other than the hot end. Commenters should provide information on such practice, including data on organic emissions (e.g., DRE results, CO and THC concentration), and suggestions on appropriate interim status controls, if any are considered necessary (i.e., in addition to the interim status standards that would be applicable to all boilers and industrial furnaces, as discussed elsewhere in today's notice).

*E. Implementation of PIC Controls During Interim Status*

1. *Preferred Option.* We believe that the PIC controls can and should be applied as soon as possible for facilities in interim status. Thus, we are requesting comment on whether the following compliance schedule is reasonable. Within 12 months of promulgation of the final rule, boilers and industrial furnaces operating under interim status must install CO monitoring equipment meeting the performance specifications presented in today's notice and determine compliance with the Tier I standard of 100 ppmv during a test burn representative of worst-case combustion conditions that will occur during interim status.[17] (Irrespective

[17] A single test burn consisting of 3 runs should be conducted to demonstrate compliance with all emissions standards—CO/THC, particulates, metals, and HCl. If simultaneous compliance testing is not practicable, however, the operating conditions of the test burns must be identical. We propose the CO and, if necessary THC, be monitored continuously for a minimum of 4 hours for each of three runs to provide a valid test burn. This time period is typical of that required for testing of destruction and removal efficiency.

of which CO format is selected (i.e., hourly rolling average or time-above-a-limit) the maximum hourly average CO level during the test burn cannot exceed 100 ppmv under Tier I.) If CO levels do not exceed 100 ppmv, CO levels are limited during interim status to 100 ppmv.

If the maximum hourly average CO level exceeds 100 ppmv during the test burn, the owner or operator must, within 15 months of promulgation of the final rule, demonstrate that the maximum hourly average THC concentration does not exceed 20 ppmv during a test burn equivalent to the Tier I test burn, using THC monitoring equipment meeting the performance specifications presented in today's notice. If the THC concentration does not exceed 20 ppmv during the test burn, then, during the period of interim status, continuous monitoring of THC would be required to ensure that THC does not exceed 20 ppmv, and continuous monitoring of CO would be required to ensure that CO does not exceed the time-weighed average CO level that occurred during the test burn.

If the maximum hourly average THC level exceeds 20 ppmv during the test burn, the owner or operator must, within 18 months of promulgation of the final rule, modify operations as necessary and demonstrate in a subsequent test burn that THC concentrations do not exceed 20 ppmv, or cease burning hazardous waste and complete closure requirements.

We are considering an exception to the 20 ppmv THC limit, however, for cement kilns that can demonstate that fuel-derived THC levels do not exceed the 20 ppmv limit even though stack gas concentrations may exceed the limit. The concern is that trace levels of organic compounds in the raw materials (e.g., limestone) can produce THC as the materials are gradually heated as they travel from the cold (i.e., feed) end of the kiln to the hot (i.e., fuel firing) end of the kiln. We specifically request comment on whether only fuel-derived THC should be considered for purposes of compliance with the proposed

THC limits. If so, we further request comment on whether the following approach is reasonable to identify fuel-derived THC. For cement kiln systems that burn or feed fuels only in the hot end of the kiln where the clinker product exists, the fuel-derived THC concentration could be determined by increasing excess oxygen levels much beyond normal levels (e.g., to 10%) and noting the minimum hourly average THC concentration that occurs. This is based on an assumption that, at high excess oxygen levels, fuel combustion efficiency will be maximized and fuel-derived THC will be virtually zero. Thus, residual THC would be attributable to organic matter in the raw materials. Accordingly, the allowable THC concentration would be 20 ppmv greater than the baseline nonfuel THC (i.e., the lowest hourly average concentration during the high excess oxygen tests). It is important to note that we are suggesting two limitations to this test: (1) only fossil fuel would be burned during the demonstration of nonfuel THC; and (2) the approach would be applicable to only those kiln systems that burn or feed fuels during the subject test in the hot end of the kiln (i.e., precalciner kilns and kilns feeding coal along with raw material in a preheater during the high excess oxygen test would not be eligible because incomplete combustion of the fuel could occur even at high excess oxygen levels).

Extensions of time may be allowable by the Regional Administrator on a case-by-case basis if circumstances beyond the owner or operator's control affect the facility's ability to comply with the above schedule.

2. *Alternate Option.* EPA is considering the following alternative approach to expedite implementation of the substantive PIC controls. Under this option, the owner or operator would be required within 18 months of promulgation of the final rule either to submit a complete Part B RCRA Permit Application, or to cease burning hazardous waste and complete closure requirements. This op-

tion has at least two major disadvantages. First, substantive controls on PIC emissions would not be applied until the Part B permit is issued. Second, the State or EPA permit officials may have higher priority facilities to handle and, thus, may not be able to process the applications for some time after they are submitted. The information provided in the permit may, in fact, become outdated before the permit officials start to process the application. In those situations, applicants may be required to submit revised, undated permit applications.

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## APPENDIX F

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 261, 264, 265, 266, 270 and 271.

[FRL-3153-5]

Burning of Hazardous Waste in Boilers and industrial Furnaces

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule and request for comment.

SUMMARY: Under this proposal, the Environmental Protection Agency (EPA) would expand controls on hazardous waste combustion to regulate the burning of hazardous waste fuels in boilers and industrial furnaces. Currently, only the burning of hazardous waste in incinerators is subject to regulation although burning hazardous waste fuels in boilers and industrial furnaces can pose similar hazards to human health and the environment. Boilers and industrial furnaces have been exempt from regulation pending Agency efforts to determine whether regulations for burning in these devices should differ from those for incineration in light of the different scope of practices and the different combustion devices and wastes involved. The Agency has completed those efforts and today proposes to control emissions of toxic organic compounds, toxic metals, and hydrogen chloride from boilers and industrial furnaces burning hazardous waste. In addition, today's proposal would subject owners and operators of these devices to the general facility standards applicable to hazardous waste treatment, storage, and disposal facilities. Further, today's proposal would subject hazardous waste fuel storage units at burner facilities to Part 264 permit standards. Burner storage operations at existing facilities are generally now subject only to interim status standards under Part 265.

Finally, today's rule proposes action on two petitions. Based on a petition by Dow Chemical Corporation, the Agency is proposing to classify halogen acid furnaces as industrial furnaces under § 260.10. Based on a petition by the American Iron and Steel Institute, EPA is proposing to classify coke and coal tar fuels produced by recycling coal tar decanter sludge, EPA Hazardous Waste No. K087, as products rather than solid waste.

## *III. Proposed Controls for Emissions of Toxic Organic Compounds*

### A. Hazard Posed by Combustion of Toxic Organic Compounds

The burning of hazardous waste containing toxic organic compounds (i.e., organic compounds listed in Appendix VIII of 40 CFR Part 261) under poor combustion conditions can result in substantial emissions of the original compounds which were not burned and compounds that result from the partial but incomplete combustion of constituents in the waste. The quantity of toxic organic compounds emitted depends on the concentration of the compounds in the waste, the waste firing rate (i.e., the percent of total boiler or industrial furnace fuel provided by the hazardous waste), and the combustion conditions under which the waste is burned. The risk posed by the emissions depends on the toxicity of the compounds emitted, and the ambient levels to which persons are exposed. Hypothetical risk assessments show that under poor combustion conditions that achieve only 99 percent or 99.9 percent destruction efficiency of organic compounds, risks to the maximum exposed individual from unburned carcinogenic organics found in hazardous waste can result in increased lifetime cancer risks of $10^{-4}$.[24]

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[24] Engineering-Science. *Background Document for the Development of Regulations To Control the Burning of Hazardous Waste in Boilers and Industrial Furnaces.* Volume III. February 1987.

B. Basis for the DRE and CO Performance Standards for Toxic Organic Compounds

The Agency is proposing to control the emission of toxic organic compounds from boilers and industrial furnaces burning hazardous waste with two performance standards. A 99.99 percent destruction and removal efficiency (DRE) standard for principal organic hazardous constituents (POHCs) in the waste feed would ensure that constituents in the waste would not be emitted at levels that could pose significant risk in virtually all scenarios of which the Agency is aware.[25] In addition, flue gas carbon monoxide (CO) levels would be limited to ensure the device operates continuously at high combustion efficiency. Thus, when burning hazardous waste, these devices cannot operate under upset conditions, which could lead to significant emissions of products of incomplete combustion (PICs), typically evidenced by smoke emissions. The basis for these standards is discussed below.

1. *Results of Emissions Testing.* The Agency conducted field tests on 11 full-scale industrial boilers and 12 industrial furnaces. The test results indicate that:

• Boilers and industrial furnaces can be operated to achieve 99.99 percent DRE of POHCs considered difficult to destroy—carbon tetrachloride, chlorobenzene, trichloroethylene, and tetrachloroethylene.

• Boilers cofiring hazardous waste fuels with fossil fuels where the hazardous waste provides less than 50 percent of the boiler's fuel requirements can achieve 99.99 percent DRE of POHCs under a wide range of operating conditions (e.g., load changes, waste feed rate changes, excess air rate changes).

• When boilers and industrial furnaces are operated at high combustion efficiency, as evidenced by flue gas

[25] Except that a 99.9999% DRE would be required for dioxin-containing listed waste.

carbon monoxide (CO) levels of less than 100 ppm, DREs exceed 99.99 percent. Although the tests showed this relationship between CO and DRE, there was no direct correlation between CO (an indicator of combustion efficiency) and DRE. Devices clearly operating under poor combusiton conditions, as evidenced, for example, by smoke emissions, still achieved 99.99 percent DRE. It appears that POHCs are immediately destroyed in the flame zone.

• Emissions of products of incomplete combustion (PICs) (i.e., quantitated Appendix VIII pollutants that are not POHCs) generally ranged from 0.5 to 5 times POHC emission rates.

• Emissions of PICs appeared generally to increase as combustion efficiency decreased as evidenced by increased flue gas CO legels.

• Emission of total unburned hydrocarbons (i.e., quantified Appendix VIII pollutants as well as unburned POHCs and other unburned organic compounds) clearly increase as combustion efficiency decreases as evidenced by an increase in flue gas CO levels.

2. *Overview of test program.* The boiler testing program had two primary purposes: (1) To determine if boilers operated under steady-state conditions to achieve maximum combustion efficiency could achieve 99.99 percent destruction and removal efficiency (DRE) of principal organic hazardous constituents (POHCs) in the waste; and (2) to determine how changes in operating conditions (e.g., waste firing rates, boiler load, excess flue gas oxygen levels) would affect the boiler's ability to achieve 99.99 percent DRE of POHCs—so-called nonsteady-state testing.

To meet the first objective (steady-state testing), EPA tested ten boilers that represented a wide variety of boiler types and sizes and that burned a variety of hazardous wastes and auxiliary fuels. The boilers ranged in type and

size from a small 8 million Btu/hr fire tube boiler to a 250 million Btu/hr water tube boiler. The hazardous wastes burned ranged from methanol and toluene wastes with a 18,500 Btu/lb heating value similar to that of No. 6 fuel oil (and which was spiked with chlorinated organics for test purposes) to a methyl acetate waste with a heating value of less than half that of No. 6 fuel oil (and which also was spiked with chlorinated organics for test purposes). Waste firing rates ranged from 100 percent of the boiler's fuel requirements (for a waste having a heating value of 9,000 Btu/lb and containing 43 percent chlorine, by weight) to less than 10 percent of the boiler's fuel requirements on a heat input basis. Boiler auxiliary fuels (if any) were natural gas, No. 6 fuel oil, pulverized coal, and waste wood.

EPA conducted nonsteady-state testing on three boilers, one of which was also tested under steady-state conditions. One boiler was a 140 million Btu/hr capacity water tube boiler that could cofire hazardous waste with either natural gas or No. 6 fuel oil. This boiler was cofired with a methyl methacrylate distillation bottom with a heating value of about 11,500 Btu/lb that was spiked with carbon tetrachloride and monochlorobenzene in concentrations ranging from 0.4 to 4.5 percent. The second boiler was a 450 million Btu/hr capacity water tube boiler also designed to cofire hazardous waste with natural gas. This boiler typically operated at a capacity of 250 million Btu/hr and was cofired with liquid organic heavy ends from a butanol/propanol production unit. The waste had a heating value of about 12,800 Btu/lb and was spiked with up to 16 percent carbon tetrachloride, monochlorobenzene, and trichlorobenzene. The third boiler was a 170 million Btu/hr capacity water tube, stoker fired boiler designed to handle an aqueous sludge for disposal (i.e., incineration or destruction). The aqueous sludge had virtually no heating value and was fired with pressure-atomized guns into the combustion zone just above the coal grate at rates of

12 to 20% of the volume of total boiler feed (i.e., sludge plus coal fuel). The sludge was spiked with 5 to 10% trichloroethylene or trichlorobenzene as tracer compounds to determine destruction and removal efficiencies.

More than 100 individual stack emission tests were conducted to determine the effect on DRE and emissions of products of incomplete combustion (PICs) of: (1) Burning hazardous waste under conditions of high and low boiler loads, high and low excess air rates, high and low waste firing rates (up to about 50 percent of the boiler's fuel requirements), and during soot blowing; (2) burning hazardous waste while boiler load, excess air rates, and waste firing rates were changed; and (3) start-up of waste firing operations.

The following industrial furnaces were tested: five cement production kilns, both dry and wet process types; two asphalt aggregate kilns; two light-weight aggregate production kilns, a lime production kiln; and a pig iron blast furnace. The results of these tests should be indicative of the ability of industrial furnaces to burn hazardous wastes efficiently.[26] The hazardous wastes burned in these industrial furnaces during the tests ranged from used oil spiked with several thousand ppm of chlorinated solvents to hazardous waste mixtures containing halogenated and nonhalogenated solvent recovery distillation bottoms and

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[26] The only other industrial furnaces known to burn hazardous waste as fuel (or to have been tested at full scale) are sulfur recovery furnaces and halogen acid furnaces. Although EPA has not conducted emissions testing of a sulfur recovery furnace and has tested only one type of halogen acid furnace (a hydrogen chloride production furnace), the Agency believes such furnaces should be able to comply with the standards proposed today and, thus, could safely burn hazardous waste. The Agency, however, specifically requests information on sulfur recovery furnaces, halogen acid furnaces, and other industrial furnaces that burn hazardous waste, including the types and quantities of wastes burned. The Agency also requests comments on whether the proposed standards would be protective for industrial furnaces not explicitly identified in proposed §§ 266.34-4(b) and (c).

spent solvents from manufacturing processes (e.g., paint manufacturing) where chlorine levels ranged from 1 to 5 percent. The heating value of the waste fuels ranged from 10,000 to 18,000 Btu/lb and the hazardous waste firing rate ranged from 100 percent for the asphalt aggregate kilns, light-weight aggregate kilns, and lime kiln to about 5 percent of the heat input to the blast furnace.

EPA did not conduct nonsteady-state testing of industrial furnaces to determine the range of operating conditions under which they could be expected to achieve 99.99 percent DRE. Given that there are five different categories of industrial furnaces that are burning (or have burned) hazardous waste and that some categories have substantially different types of devices (e.g., wet versus dry process cement kilns, drum mix versus batch mix asphalt operations), EPA believes that the cost of nonsteady-state testing for each type of industrial furnace would be prohibitive. Moreover, the primary purpose for the boiler nonsteady-state testing was to determine if operating conditions cou'd be specified such that the device could be assumed to be achieving 99.99 percent DRE without the need for a trial burn to demonstrate DRE. Based on the boiler testing, EPA is proposing an automatic waiver of the trial burn for owners and operators who operate the boiler under special operating requirements. The basis for that approach is discussed in Section III.C below. EPA believes that this approach may allow many of the 900 boilers burning hazardous waste to avoid the expense of conducting trial burns. Given that EPA believes that there may be only about 50 industrial furnaces burning hazardous waste and given the cost of testing five to seven or more industrial furnaces operated under nonsteady-state conditions, EPA does not believe that such a testing program for industrial furnaces would be cost-effective. Thus, as discussed below, EPA is proposing that owners and operators of all industrial furnaces, as well as those boilers not operated under the proposed special conditions, conduct trial burns to demonstrate conformance with the DRE standard.

3. *Interpretation of test results.* The boilers tested under nonsteady-state conditions achieved 99.99 percent DRE of POHCs under nearly all operating conditions tested. It would not be appropriate, however, to assume that any boiler buring any hazardous waste fuel under any waste firing and boiler operating conditions will achieve 99.99 percent DRE. Although the nonsteady-state tests varied a number of parameters over a wide range, some parameters could not be tested at the three test sites and other parameters could not be tested over their full range. As examples, hazardous waste was not fired with nonfossil fuels like waste wood, the maximum waste firing rate tested was 56 percent on a heat input basis, the boilers were not operated at loads below about 25 percent, and excess oxygen levels in the flue gas did not exceed 10 percent. Parameters such as these can affect boiler combustion efficiency and, thus, destruction of toxic organic constituents in the hazardous waste and emissions of incompletely burned organics. (See discussion below.) Although most of the appropriate parameters were tested at the "extremes" during one or more of the 11 steady-state tests discussed above, the boilers were operated during these tests under constant conditions in an attempt to achieve peak combustion efficiency. Thus, we do not know how narrow the envelope of operating conditions may be to ensure peak combustion efficiency and 99.99 percent DRE for a boiler already operating at the "extremes" (e.g., burning hazardous waste with a heating value of 1,000-8,000 Btu/lb as primary fuel; burning 100 percent hazardous waste with a heating value of less than 9,000 Btu/lb; or operating at a very low load).

4. *Basis for the DRE standard.* EPA is proposing a 99.99 percent DRE performance standard for POHCs [27]

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[27] Except that, as required for incinerators, a 99.99 percent DRE would be required for the dioxin-containing wastes: EPA Hazardous Wastes F020, F021, F022, F023, F026, and F027. See § 264.343(a)(2).

because it is protective, it can be readily achieved by boilers and industrial furnaces as discussed above, and it would ensure that the Agency's controls are consistent for all combustion devices—boilers, industrial furnaces, and incinerators—that pose similar risks.

Hypothetical risk assessments have shown that a 99.99 percent DRE standard for POHCs is protective in virtually every scenario of which the Agency is aware.[28] Increased lifetime cancer risks to the maximum exposed individual would generally be 10 or less. Threshold (i.e., noncarcinogenic) organic compounds as well would not be expected in hazardous waste burned in these devices at levels that could pose a health hazard under the 99.99 percent DRE standard.

It should be noted, however, that the DRE standard does not directly control the mass emission rate (e.g., pounds per hour) of unburned POHC. Although there could be hypothetical situations where risks from POHCs could be significant under a 99.99 percent DRE standard (e.g., boilers or industrial furnaces located in urban areas burning high volumes of waste with high concentrations of highly potent carcinogenic organics), the Agency is not aware of any such situations. (See Section I of Part Two of this preamble.) If, however, during the permit process, it appears that high risk scenarios exist, permit officials can use the omnibus provision of Section 3005(c) of HSWA to develop permit requirements, as necessary, to protect human health and the environment (e.g., by requiring a 99.9999 percent DRE, by limiting the feed rate of particularly toxic compounds, or by setting a mass emission rate).

EPA specifically requests comments on using surrogate compounds in lieu of POHCs (actual constituents in the

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[28] Engineering Science. *Background Information Document for the Development of Regulations to Control the Burning of Hazardous Waste in Boilers and Industrial Furnaces.* Volume III, January 1987.

waste) to demonstrate DRE during a trial burn. To be useful as universal surrogates, such compounds must be more difficult to destroy than any principal organic constituent in the waste. Thus, the surrogates should have a low heat of combustion (e.g., carbon tetrachloride), the conventional index for predicting incinerability. In addition, in light of work conducted by the University of Dayton Research Insttute,[29] the surrogates should also have a high gas phase thermal stability under low oxygen conditions (e.g., monochlorobenzene, trichoroethylene). Further, the surrogates need not be limited to toxic compounds listing in Appendix VIII of Part 261. Other compounds, notably $SF_6$, appear to have very high thermal stability and may be useful as a universal surrogate.[30] To be conservative, it appears appropriate to select several compounds as surrogates—one or two compounds that have low heat of combustion, and one or two compounds that have high thermal stability. Such compounds could be used as a universal mixture of surrogates, or "POHC soup". EPA specifically requests comments on this approach to simplify and standardize DRE testing.

5. *Basis for the CO standard.* EPA is proposing to limit flue gas carbon monoxide (CO) levels to ensure that boilers and industrial furnaces are operated at high combustion efficiency when burning hazardous waste. Thus, emissions of incompletely burned organic compounds are expected to be minimized to levels that would not pose significant risk.

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[29] Dr. Barry Dellinger, Michael D. Graham, and Debra A. Tiney, University of Dayton, Research Institute, "Predicting Emissions from the Thermal Processing of Hazardous Wastes", *Hazardous Waste and Hazardous Materials*, Volume 3. November 3, 1986.

[30] Dr. Philip H. Taylor and Dr. John Chadbourne, "$SF_6$ as a Surrogate for Measuring Hazardous Waste Incinerator Performance", submitted for publication to Journal of Air Pollution Control Association, March 1987.

a. *PIC Emissions.* EPA evaluated emissions of products of incomplete combustion (PICs) by quantifying emissions of priority pollutants that were not constituents in the waste (and evaluated as POHCs). PIC emission rates varied from about 0.1 to over 100 times POHC emission rates, but generally ranged from 0.5 to 5 times POHC emission rates. Semivolatile PIC emissions were nearly always insignificant compared to the levels of volatile PICs. Thus, large molecular weight (semivolatile) compounds apparently were not being synthesized. (We note, however, that laboratory studies have shown that single chlorinated organic compounds can produce several chlorinated PICs. These PICs were not limited to simple fragments of the parent POHC but included higher order chlorinated organics.)

Typical chlorinated PICs found during the full scale boiler testing included chloroform, trichloroethane, tetrachloroethylene, dichloromethane, chloromethane, and carbon tetrachloride. In addition, two nonchlorinated PICs were nearly always found—benzene and toluene.

EPA also evaluated dioxin emissions from boilers cofired with hazardous waste fuel. Emission of chlorinated dioxins and chlorinated furans, their tetra, penta, hexa, hepta and octa homologs, as well as the highly toxic isomer, 2,3,7,8-TCDD were quantified during steady-state testing of five boilers.[31] Four of the boilers were oil, gas, or pulverized coal boilers typical of those that burn hazardous waste fuels. These boilers ranged in capacity from 100 to 340 MM Btu hr and fired hazardous waste generally at rates of 20 to 47 percent of total heat input. Emissions of total PCDD (polychlorinated dibenzo-p-dioxins) ranged from less than 0.08 to 1.1 nanograms/cubic meter of flue gas (0.0048—0.066 ppt)[32] and emis-

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[31] Acurex Corporation, *Dioxin Emissions from Industrial Boilers Burning Hazardous Materials*, April 1985.

[32] ppt: parts per trillion.

sions of total PCDF (polychlorinated dibenzo-furan) ranged from 0.14 to 5.5 nanograms/cubic meter (0.0084-0.33 ppt). The highly toxic isomer, 2,3,7,8-TCDD, was found in the emission from only one boiler and at a level equal to the detection limit of 0.002 nanograms/cubic meter.

The fifth test boiler was a 100 MM Btu/hr wood-fired stoker boiler. The boiler cofired creosote sludge at a 40 percent heat input firing rate with wood chips, bark, and sawdust. As is typical of batch-feed wood-fired stokers, large and frequent fluctuations in excess air and carbon monoxide emissions were indicative of erratic combustion conditions. Emissions of total PCDD were 76 nanograms/cubic meter of flue gas (4.56 ppt). PCDF emissions were not determined. Emissions of 2,3,7,8-TCDD were not detected at a detection limit of 0.002 nanograms/cubic meter (0.00014 ppt).

We note that there is a substantial degree of uncertainty associated with quantifying the emission of unburned organics. The test results can over or underestimate the emission of unburned organics attributed to burning hazardous waste fuels. Hazardous wastes were cofired with fossil fuels during most of the test burns. Any fossil fuel PIC was included as a PIC generated by the hazardous waste. Fossil fuel combustion is known typically to generate the PICs benzene and toluene and, if the fossil fuel contains chlorine (e.g., coal), many of the hazardous waste chlorinated PICs listed above could also be generated by the fossil fuel. In addition, some of the organic compounds identified during EPA's testing as PICs may, in fact, result from contamination from sampling train absorbent, laboratory solvents, or from such sources as freon leaks from a refrigerator used to store samples prior to analysis.

PIC emissions could also be underestimated because only those organic compounds listed as toxic constituents

of hazardous waste in Appendix VIII of Part 261 were quantified and designated as PICs. Although GC/MS analysis was used to quantify about 100 of these compounds, many other unburned organic compounds were undoubtedly emitted. Some of these compounds are undoubtedly toxic even though they are not listed in Appendix VIII.

Although additional research is needed to understand combustion reactions where organic constituents in hazardous waste are first "destroyed" and where intermediate products of combustion are formed until ultimately, and ideally, all hydrocarbons are converted to carbon dioxide and water, the available data lead the Agency to conclude: (1) the risk posed by PIC emissions is probably not significant when combustion devices achieve 99.99 percent DRE of POHCs even though they may operate at less than maximum combustion efficiency; and (2) nonetheless, given the uncertainties as to the types and quantities of PICs that may be emitted when a combustion device is not operated at high combustion efficiency, it is prudent to provide controls that ensure that boilers and industrial furnaces are operated at high combustion efficiency when burning hazardous waste. Both of these points are discussed below.

b. *Risk from PIC emissions.* As discussed above, test data indicate that PICs are generally emitted at rates of from 0.5 to 5 times the rate of POHCs. Given that the preponderance of the PICs were relatively low molecular weight, volatile compounds even when the POHCs were high molecular weight, semivolatile compounds, and, given that the carcinogenic PICs have potencies similar to the POHCs. As discussed above, the increased lifetime cancer risk from unburned POHC emissions at a 99.99 percent DRE is on the order of $10^{-6}$ or less. Thus, PICs emitted at a rate of 0.5 to 5 times POHC rates would increase risks by less than half an order of magnitude—to $10^{-5}$ or less.

Although some dioxins (e.g., 2,3,7,8-TCDD) are orders of magnitude more potent than the other PICs (and POHCs) identified during the testing program, the emission of dioxins and furans were found to be virtually insignificant. Emission rates for all dioxin and furan homologs were converted to 2,3,7,8-TCDD emissions equivalents to estimate the increased limetime cancer risk to the maximum exposed individual under reasonable, worst case scenarios. The risk from dioxin and furan emissions appears on the order of $10^{-7}$.

c. *Use of CO limits to ensure high combustion conditions.* Generally accepted combustion theory holds that low CO (carbon monoxide) flue gas levels are indicative of a boiler, industrial furnace, or incinerator operating at high combustion efficiency. Operating at high combustion effiiciency conditions helps ensure minimum emissions of unburned (or incompletely burned) organics.[33] In the first stage of combustion of hazardous waste fuel, the POHCs are immediately thermally decomposed in the flame to form other, usually smaller, compounds termed PICs (products of incomplete combustion). In this first stage of combustion, these PICs are also rapidly decomposed to form CO.

The second stage of combustion involves the oxidation of CO to $CO_2$ (carbon dioxide). The CO to $CO_2$ step is the slowest (rate controlling) step in the combustion process because CO is considered to be more thermally stable (difficult to oxidize) than other intermediate products of combustion of hazardous waste constituents. Since

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[33] Given that CO is a gross indicator of combustion performance, limiting CO may not absolutely minimize PIC emissions. This is because PICs can result from small pockets within the combustion zone where adequate time, temperature, and turbulence have not been provided to oxidize completely the combustion products of the POHCs. Available data, however, indicate that PIC emissions do not pose significant risk when combustion devices are operated at high combustion efficiency. EPA is conducting additional field and pilot scale testing to address this issue.

fuel is continuously being fired, both combustion stages are occurring simultaneously.

Using this view of waste combustion, the "destruction" of a POHC, and perhaps even the destruction of PICs, is independent of flue gas CO levels. Thus, CO flue gas levels cannot be correlated to DRE for POHCs and may not correlate well with PIC destruction. (As discussed above, test data show no correlation between CO and DRE, a slight apparent correlation between CO and chlorinated PICs, and a fair correlation between CO and total unburned hydrocarbons.) Low CO is an indicator of the status of the CO to $CO_2$ conversion process, the last, rate-limiting oxidation process. Since oxidation of CO to $CO_2$ occurs after destruction of the POHC and its (other) intermediates (PICs), the absence of CO is a useful indication of POHC and PIC destruction. The presence of high levels of CO in the flue gas is a useful indication of inefficient combustion and, at some level of elevated CO flue gas concentration, an indication of failure of the PIC and POHC destruction process. We believe it is necessary to limit CO levels to levels indicative of high combustion efficiency because we do not know the precise CO level that is indicative of significant failure of the PIC and POHC destruction process. In fact, that critical CO level may be dependent on site-specific and event-specific factors (e.g., fuel type, fuel mix, air to fuel ratios, rate and extent of change of these and other factors that affect combustion efficiency). We believe limiting CO levels is also reasonable because: (1) it is a widely practiced approach to monitoring combustion efficiency—many boilers and industrial furnaces are already equipped with flue gas oxygen monitors [34] and

[34] Oxygen monitoring would be required in conjunction with CO monitoring to adjust CO levels to a common excess air rate indicated by excess oxygen content in the flue gas. Correcting CO levels to a common flue gas oxygen content avoids the problem of having (otherwise) high CO levels diluted by large quantities of excess air. This issue is discussed further in the next section of the text.

some are equipped with CO monitors; (2) although the annualized cost of oxygen and CO monitoring is estimated to be $20,000 (see Section II of Part Six), the monitors may in part pay for themselves in fuel savings resulting from operating the boiler or industrial furnace closer to maximum combustion efficiency; and (3) well designed and operated boilers and industrial furnaces can easily be operated in conformance with the proposed CO limits.

d. *Proposed CO limits.* The Agency is proposing the following limits on flue gas carbon monoxide (CO) levels, corrected to a 7 percent flue gas oxygen content.

| CO limits | Consequence of exceeding limit |
|---|---|
| If >100 ppm average for any 60 minute period (rolling average). | Waste feed shutoff within 10 minutes. |
| If >500 ppm average for any 10 minute period (rolling average). | Immediate waste feed shutoff. |

Both limits would apply. Test burn data and discussions with owners and operators of boilers and industrial furnaces indicate that these CO limits are readily achievable.[35]

[35] We note, however, that boilers that are well-operated (and typically equipped with CO monitors) may operate at CO levels of 150 to 250 ppm to maximize boiler efficiency. To optimize boiler efficiency (i.e., minimize the fuel required to generate 1,000 lbs. of steam), boilers are operated under slightly fuel-rich conditions. The energy lost from the relatively high stack gas CO levels is more than offset by the energy that would be required to heat ambient air fed to the combustion zone to increase fuel burnout (i.e., CO combustion, and combustion of carbon in coal and oil ash). Thus, to meet the proposed CO standards, some well-operated, finely-tuned boilers may have to operate at a lower boiler efficiency to operate at the high combustion efficiency required by the proposed CO limits. EPA believes that few boilers burning hazardous waste are currently equipped with CO monitors and would be re-

The 100 ppm limit is indicative of steady-state (i.e., normal), efficient combustion conditions. The higher limit of 500 ppm and the time weighted average for both limits are provided to accommodate the CO spikes that inevitably occur when hazardous waste fuel firing starts or when, for example, there is a load change on an industrial boiler. Test burn data and discussions with owners and operators indicate that the proposed limits and duration of exceedences will enable owners and operators to bring combustion conditions back to maximum efficiency after normal, routine "upsets" caused by initiating waste firing, load changes, etc.

Given that CO is a sensitive indicator of overall combustion conditions and may be a conservative indicator of POHC and PIC destruction, we are proposing time-weighted averages of exceedences rather than fixed limits. Fixed limits that do not acknowledge inevitable CO spikes and that do not give owners and operators time to retune combustion conditions could actually result in greater emission of incompletely burned organics. This is because each time hazardous waste firing is interrupted, CO will spike and emission of incompletely burned organics may increase. Thus, any controls on CO must strike a balance between the organic emissions that result from an overly-stringent CO limit that requires frequent waste feed interruptions versus the emissions that result from less stringent controls that acknowledge inevitable CO spikes.

We are proposing that the CO limits be based on a flue gas oxygen content of 7 percent. It is necessary to correct CO levels for flue gas oxygen content because (otherwise) high CO flue gas concentrations could be diluted by high rates of excess air. Although a boiler or industrial furnace may be operating under conditions that result in

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quired to operate under less thermally efficient conditions under this proposal. Nonetheless, the Agency specifically requests comments on this issue.

poor combustion efficiency and a high CO mass emission rate per unit of time, CO flue gas concentrations could be diluted to levels that meet the proposed limits if the device were operated at high excess air rates (which in itself could reduce combustion efficiency and increase the CO mass emission rate [36]).

We are proposing that CO be corrected to a flue gas oxygen content of 7 percent because we believe that the majority of boilers and industrial furnaces require flue gas oxygen levels of about 7 percent when burning hazardous waste at high combustion efficiency. We are aware, however, that optimum flue gas oxygen levels may range from 3 percent to 10 percent for these devices. Further, the optimum oxygen level to achieve high combustion efficiency for a given device will vary depending on factors such as fuel mix and boiler load. Although large combustion devices generally have optimum oxygen requirements on the low end of the range and smaller units on the upper end of the range, we believe that a level of 7 percent is reasonable given that it is in the middle of the range and that the majority of devices burning hazardous waste fuels have moderate heat input capacities (e.g., 20-150 MM Btu/hr).

We should note that, for the smaller devices with optimum oxygen requirements greater than 7 percent, as the gap widens between their optimum oxygen level and the 7 percent oxygen level selected for correcting CO levels, the CO limits effectively become more stringent. Even though these smaller devices may be operating at optimum excess air levels (i.e., at greater than 7 percent excess oxygen levels) and achieving high combustion efficiency and minimum CO levels, the proposed correction factor of 7 percent oxygen in effect presumes they should be operating at a lower excess air level. Thus, this approach

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[36] High excess air rates can decrease combustion efficiency by "quenching" the flame with cooler ambient air resulting in lower combustion zone temperatures, and, ultimately, an unstable flame.

presumes their CO levels have been diluted and requires a correction to the lower excess oxygen rate. For purposes of determining compliance with the proposed CO limits, their actual CO levels would be increased to those that would result from the "optimum" excess oxygen level of 7 percent.

Larger devices with optimum oxygen levels lower than 7 percent would not be adversely affected, since correcting to 7 percent oxygen would lower their measured CO levels.

EPA specifically requests comments on whether the proposed approach for limiting CO levels is appropriate, including the proposed limits, averaging times, and the requirement to correct CO levels to 7 percent flue gas oxygen levels. We also specifically request comment on whether a limit is needed on the number of CO spikes per unit of time in addition to the proposed time-weighted average limits. A device could be operating during an extended period of frequent combustion upsets without necessarily exceeding the proposed time-weighted averages. Comments are requested on this option, including on appropriate CO trigger spike level (e.g., 300 ppm) and an appropriate limit on the frequency (e.g., no more than 10 spikes per 15 minutes). Comments should include supporting documentation or data for any of the above issues.

EPA is specifically requesting comments on the appropriateness of these CO limits for cement kilns. Recently, it has come to the Agency's attention that cement kilns may have a problem meeting the proposed CO limits. Apparently, trace organic materials in the feedstock are burned-off as the feedstock moves through the kiln from the feed end to the hot end where fuels are fired. The burning of these trace organic materials apparently causes cement kilns to have a high baseline CO emission rate (e.g., 200-350 ppm) that is unrelated to the combustion of fuels in the hot end of the kiln. Therefore, EPA is

requesting comments on: (1) Whether a different set of CO limits should be implemented for these devices (e.g., the proposed limits superimposed on a baseline CO emission rate); or (2) whether another monitoring method (e.g., nitrogen oxides) should be used for these devices. Commenters should document their positions keeping in mind that the Agency's goal is to provide for continuous monitoring of combustion efficiency to minimize PIC emissions from the burning of hazardous wastes.

EPA is proposing that if the 100 ppm time-weighted average limit is exceeded, the hazardous waste feed must be shutoff within 10 minutes. This allows the operator time to effect a controlled waste shutoff and to switch to another fuel. If, however, the 500 ppm time-weighted average limit is exceeded, we are proposing that the hazardous waste feed be shutoff immediately given that the device is in a major upset condition and is not operating anywhere close to high combustion efficiency.[37] Further, we are proposing that the hazardous waste feed cannot be restarted after a required shutoff until the operator demonstrates that the device can operate at maximum combustion efficiency for a reasonable period of time. Thus, we are proposing that hazardous waste firing cannot resume until the device is operated without exceeding a time-weighted average CO level of 100 ppm for an averaging period of not less than 10 minutes nor more than 60 minutes. We are proposing the 60 minute maximum averaging time period given that it is the basic CO performance standard indicating high combustion efficiency. If an operator can retune his boiler quickly, however, we do not believe he should have to wait the

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[37] EPA specifically requests comments on whether a controlled waste feed shutoff (e.g., over a 2-minute period) would be more appropriate than an immediate shutoff requirement when the 500 ppm limit is exceeded. A controlled shutoff may result in lower emissions of unburned organic compounds by allowing the operator to replace gradually the hazardous waste with other fuels, thus reducing "shock" to the combustion process.

60 minutes required under the basic CO standard to demonstrate that his CO levels do not exceed 100 ppm on average. Given that shorter averaging periods are actually more stringent because the operator has less time to offset CO levels greater than 100 ppm with levels lower than 100 ppm, we believe that shorter periods should be allowed. A 10 minute minimum averaging period is proposed because it is short enough to allow operators to resume burning hazardous waste quickly once they retune combustion controls and long enough to demonstrate that low CO levels can be maintained.

We are proposing that, if the CO limits are exceeded an aggregate of 10 times in a calendar month, the owner or operator must cease burning hazardous waste and notify the Regional Administrator in writing within 5 calendar days. In addition, the owner or operator may not resume burning hazardous waste unless and until written permission is received from the Regional Administrator. Depending on the circumstances, the Regional Administrator may modify the permit requirements (or place special conditions on interim status operations) to ensure that the device can be operated within the CO limits or to minimize the risks from emissions of incompletely burned organics if the device continues to exceed the limits. Those special conditions could include limits on waste firing rates and the types of waste that may be burned to ensure that the CO standard can be met. EPA specifically requests comments on this approach.

Finally, EPA is proposing to apply the CO (and DRE) requirements for blast furnace systems burning hazardous waste only to the stoves and boilers burning the blast furnace off-gas. These devices use approximately 93 percent of the off-gas generated (see Part One, Section IV.B.4 of this preamble). The remaining off-gas is burned in miscellaneous devices such as coke ovens, reheat furnaces, flares, etc. EPA is proposing not to limit CO (and DRE) from these burners since they burn such

a small percentage of the off-gas. EPA specifically requests comments on whether this approach is appropriate.

C. Waiver of Trial Burns for Boilers Operated Under Special Operating Requirements

The DRE performance standard would be implemented for boilers and industrial furnaces very much as it is currently implemented for incinerators under Subpart O of Part 264, with one major exception for certain boilers, as discussed below. Industrial furnaces and boilers not operated under certain special conditions would demonstrate by conducting a trial burn that they can achieve the required DRE (99.9999 percent for dioxin-containing wastes and 99.99 percent for all other wastes) for specific organic compounds identified in the hazardous waste feed.

As a result of the nonsteady-state boiler testing discussed above, EPA believes that boilers operated under the special operating requirements discussed below will maintain a hot, stable, primarily fossil fuel flame conducive to maintaining high combustion efficiency, and resulting in maximum destruction of organic constituents in the hazardous waste fuel. EPA believes that these boilers will achieve at least a 99.99 percent DRE of organic constituents in the waste, and, therefore, a trial burn to demonstrate DRE is not necessary. Thus, EPA is proposing to waive automatically the requirement to conduct a trial burn to demonstrate DRE for boilers operated under the special operating requirements.[38]

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[38] Emissions testing for boilers operating under the special operating requirements would be avoided entirely if the hazardous waste meets the proposed specification levels for certain metals and chlorine, as discussed in Sections III and IV of Part Three of the preamble. We note that even when emissions testing would not be required under today's proposed rule, a permit under the normal permitting procedures (e.g., Part A and Part B permit applications, opportunity for public hearings) would still be required. See Seection I.A.2 of Part Four of the preamble for an explanation.

Although the steady-state boiler tests indicate that boilers operating outside of the envelope of the special operating requirements identified below can also be operated to achieve maximum combustion efficiency and at least 99.99 percent DRE, the less the boiler operates as a primarily fossil fuel burner the greater the uncertainty that a hot, stable, and efficient flame can be maintained continuously. Thus, case-by-case trial burns would be required for those boilers (and all industrial furnaces) to determine that set of operating conditions necessary to ensure 99.99 percent DRE.

The special operating requirements requisite to an automatic waiver of a trial burn to demonstrate DRE require that: (1) The boiler must burn at least 50 percent of the fossil fuels oil, gas, or coal; (2) the boiler must be operated at a load of at least 25 percent of its rated capacity; (3) the hazardous waste fuel must have a heating value of at least 8,000 Btu/lb; and (4) the hazardous waste fuel must be fired with an atomization firing system. In addition to these special conditions for the waiver of a trial burn, these boilers, like other boilers and all industrial furnaces, would be subject to the carbon monoxide flue gas limits (implemented by continuous monitoring of CO and oxygen) discussed above, and could not burn hazardous waste during boiler start-up or shut-down operations. The basis for these requirements is discussed below.

1. *A minimum of 50 percent of the fuel fired to the boiler must be gas, oil or coal.* Cofiring with fossil fuels (or fuels derived from fossil fuels) as the primary fuel is required to ensure a hot, stable flame conductive to destruction of organic constituents in the waste. Other fuels (e.g., wood waste) may not provide hot, stable combustion zone conditions.

A minimum fossil fuel firing of 50 percent, on a total heat input or volume input basis, whichever results in the greater volume of fossil fuel, would be required to

ensure a hot, stable flame. We are proposing a minimum 50 percent fossil fuel burning requirement because nearly all of the nonsteady-state boiler tests were conducted with hazardous waste cofired with oil or gas at less than a 50 percent firing rate. We specifically request comments and any relevant supporting data on whether the proposed 50 percent minimum firing rate is appropriate.

2. *Boiler load must be at least 25 percent.* We are proposing to limit boiler load when burning hazardous waste fuel to 25 percent of the boiler's rated heat input capacity because the combustion flame can be cooler and less stable at very low load factors. At low loads, higher excess air rates are used to improve fuel/air mixing. The increased excess air rates, however, can also cool the flame zone and even make the flame unstable (e.g., as a candle flame flickers in a breeze). These conditions can result in reduced combustion efficiency and destruction of organic constituents in the waste. Finally, EPA's nonsteady-state boiler tests were conducted at boiler loads of greater than 25 percent.

We specifically request comment and supporting documentation on whether the minimum 25 percent limit on boiler load is appropriate.

* * * *

**APPENDIX G**

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1993

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No. 91-1221

HORSEHEAD RESOURCE DEVELOPMENT COMPANY, INC.

v.

U.S. ENVIRONMENTAL PROTECTION AGENCY
and Consolidated Cases

---

Before: Wald, Edwards and Buckley, Circuit Judges

ORDER

[Filed Apr. 29, 1994]

Upon consideration of petitioners' Petition for Rehearing, filed April 8, 1994, it is

ORDERED, by the Court, that the petition is denied.

*Per Curiam*
FOR THE COURT:
RON GARVIN
Clerk

By: /s/ Robert A. Bonner
ROBERT A. BONNER
Deputy Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1993

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No. 91-1221

HORSEHEAD RESOURCE DEVELOPMENT COMPANY, INC.

v.

U.S. ENVIRONMENTAL PROTECTION AGENCY
and Consolidated Cases

---

Before: Mikva, Chief Judge; Wald, Edwards, Silberman, Buckley, Williams, Ginsburg, Sentelle, Henderson, Randolph and Rogers, Circuit Judges

ORDER

[Filed Apr. 29, 1994]

Petitioners' Suggestion For Rehearing *In Banc* has been circulated to the full Court. No member of the Court requested the taking of a vote thereon. Upon consideration of the foregoing it is

ORDERED, by the Court *in banc,* that the suggestion is denied.

*Per Curiam*
FOR THE COURT:
RON GARVIN
Clerk

By: /s/ Robert A. Bonner
ROBERT A. BONNER
Deputy Clerk

## APPENDIX H

## REGULATIONS INVOLVED

§ 266.104 Standards to control organic emissions.

* * * *

(f) * * *

(1) When the baseline HC (and CO) level is determined, the owner or operator must demonstrate that the facility is designed and operated to minimize hydrocarbon emissions from fuels and raw materials and that the facility is producing normal products under normal operating conditions feeding normal feedstocks and fuels. The baseline HC level is defined as the average over all valid test runs of the highest hourly rolling average HC value for each run when the facility does not burn hazardous waste, adjusted as appropriate to consider the variability of hydrocarbon levels under good combustion operating conditions. The baseline CO level is determined based on the test runs used to establish the baseline HC level and is defined as the average over all test runs of the highest hourly rolling average CO value for each run. More than one baseline level must be determined if the facility operates under different modes that may generate significantly lower HC (and CO) levels;

* * * *

§ 266.100 Applicabiliy.

(a) The regulations of this subpart apply to hazardous waste burned or processed in a boiler or industrial furnace (as defined in § 260.10 of this chapter) irrespective of the purpose of burning or processing, except as provided by paragraphs (b), (c), and (d) of this section. In this subpart, the term "burn" means burning for energy recovery or destruction, or processing for materials recovery or as an ingredient. The emissions standards of §§ 266.104, 266.105, 266.106, and 266.107 apply to fa-

cilities operating under interim status or under a RCRA operating permit as specified in §§ 266.102 and 266.103.

(b) The following hazardous wastes and facilities are not subject to regulation under this subpart:

(1) Used oil burned for energy recovery that is also a hazardous waste solely because it exhibits a characteristic of hazardous waste identified in subpart C of part 261 of this chapter. Such used oil is subject to regulation under subpart E of part 266 rather than this subpart;

(2) Gas recovered from hazardous or solid waste landfills when such gas is burned for energy recovery.

(3) Hazardous wastes that are exempt from regulation under §§ 261.4 and 261.6(a)(3) (v-viii) of this chapter, and hazardous wastes that are subject to the special requirements for conditionally exempt small quantity generators under § 261.5 of this chapter.

(4) Coke ovens, if the only hazardous waste burned is EPA Hazardous Waste No. K087, decanter tank tar sludge from coking operations.

(c) Owners and operators of smelting, melting, and refining furnaces (including pyrometallurgical devices such as cupolas, sintering machines, roasters, and foundry furnaces, but not including cement kilns, aggregate kilns, or halogen acid furnaces burning hazardous waste) that process hazardous waste solely for metal recovery are conditionally exempt from regulation under this subpart, except for §§ 266.101 and 266.112.

(1) To be exempt from §§ 266.102 through 266.111, an owner or operator must:

(i) Provide a one-time written notice to the Director indicating the following:

(A) The owner or operator claims exemption under this paragraph;

(B) The hazardous waste is burned solely for metal recovery consistent with the provisions of paragraph (c)(2) of this section;

(C) The hazardous waste contains recoverable levels of metals; and

(D) The owner or operator will comply with the sampling and analysis and recordkeeping requirements of this paragraph;

(ii) Sample and analyze the hazardous waste and other feedstocks as necessary to comply with the requirements of this paragraph under procedures specified by Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, incorporated by reference in § 260.11 of this chapter; and

(iii) Maintain at the facility for at least three years records to document compliance with the provisions of this paragraph including limits on levels of toxic organic constituents and Btu value of the waste, and levels of recoverable metals in the hazardous waste compared to normal nonhazardous waste feedstocks.

(2) A hazardous waste meeting either of the following criteria is not processed solely for metal recovery:

(i) The hazardous waste has a total concentration of organic compounds listed in part 261, appendix VIII, of this chapter exceeding 500 ppm by weight, as-generated, and so is considered to be burned for destruction; or

(ii) The hazardous waste has a heating value of 5,000 Btu/lb or more, as-generated or as-fired into the furnace, and so is considered to be burned as fuel.

(d) The standards for direct transfer operations under § 266.111 apply only to facilities subject to the permit standards of § 266.102 or the interim status standards of § 266.103.

(e) The management standards for residues under § 266.112 apply to any boiler or industrial furnace burning hazardous waste.

(Approved by the Office of Management and Budget under control number 2050-0073)

§ 266.101 Management prior to burning.

(a) *Generators.* Generators of hazardous waste that is burned in a boiler or industrial furnace are subject to part 262 of this chapter.

(b) *Transporters.* Transporters of hazardous waste that is burned in a boiler or industrial furnace are subject to part 263 of this chapter.

(c) *Storage facilities.* (1) Owners and operators of facilities that store hazardous waste that is burned in a boiler or industrial furnace are subject to the applicable provisions of subparts A through L of part 264, subparts A through L of part 265, and part 270 of this chapter, except as provided by paragraph (c)(2) of this section. These standards apply to storage by the burner as well as to storage facilities operated by intermediaries (processors, blenders, distributors, etc.) between the generator and the burner.

(2) Owners and operators of facilities that burn, in an on-site boiler or industrial furnace exempt from regulation under the small quantity burner provisions of §266.108, hazardous waste that they generate are exempt from regulation under subparts A through L of part 264, subparts A through L of part 265, and part 270 of this chapter with respect to the storage of mixtures of hazardous waste and the primary fuel to the boiler or industrial furnace in tanks that feed the fuel mixture directly to the burner. Storage of hazardous waste prior to mixing with the primary fuel is subject to regulation as prescribed in paragraph (c)(1) of this section.

§ 266.102 Permit standards for burners.

(a) *Applicability*—(1) *General.* Owners and operators of boilers and industrial furnaces burning hazardous waste and not operating under interim status must comply with the requirements of this section and §§ 270.22 and 270.66 of this chapter, unless exempt under the small quantity burner exemption of § 266.108.

(2) *Applicability of part 264 standards.* Owners and operators of boilers and industrial furnaces that burn hazardous waste are subject to the following provisions of part 264 of this chapter, except as provided otherwise by this subpart:

(i) In subpart A (General), 264.4;

(ii) In subpart B (General facility standards), §§ 264.11-264.18;

(iii) In subpart C (Preparedness and prevention), §§ 264.31-264.37;

(iv) In subpart D (Contingency plan and emergency procedures), §§ 264.51-264.56;

(v) In subpart E (Manifest system, recordkeeping, and reporting), the applicable provisions of §§ 264.71-264.77;

(vi) In subpart F (Corrective Action), §§ 264.90 and 264.101;

(vii) In subpart G (Closure and post-closure), §§ 264.111-264.115;

(viii) In subpart H (Financial requirements), §§ 264.141, 264.142, 264.143, and 264.147-264.151, except that States and the Federal government are exempt from the requirements of subpart H; and

(ix) Subpart BB (Air emission standards for equipment leaks), except §§ 264.1050(a).

(b) *Hazardous waste analysis.* (1) The owner or operator must provide an analysis of the hazardous waste that quantifies the concentration of any constituent identified in appendix VIII of part 261 of this chapter that may reasonably be expected to be in the waste. Such constituents must be identified and quantified if present, at levels detectable by analytical procedures prescribed by Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods (incorporated by reference, see § 260.11 of this chapter). The appendix VIII, part 261 constituents excluded from this analysis must be identified and the basis for their exclusion explained. This analysis will be used to provide all information required by this subpart and § 270.22 and § 270.66 of this chapter and to enable the permit writer to prescribe such permit conditions as necessary to protect human health and the environment. Such analysis must be included as a portion of the part B permit application, or, for facilities operating under the interim status standards of this subpart, as a portion of the trial burn plan that may be submitted before the part B application under provisions of § 270.66(g) of this chapter as well as any other analysis required by the permit authority in preparing the permit. Owners and operators of boilers and industrial furnaces not operating under the interim status standards must provide the information required by §§ 270.22 or 270.66(c) of this chapter in the part B application to the greatest extent possible.

(2) Throughout normal operation, the owner or operator must conduct sampling and analysis as necessary to ensure that the hazardous waste, other fuels, and industrial furnace feedstocks fired into the boiler or industrial furnace are within the physical and chemical composition limits specified in the permit.

(c) *Emissions standards.* Owners and operators must comply with emissions standards provided by §§ 266.104 through 266.107.

(d) *Permits.* (1) The owner or operator may burn only hazardous wastes specified in the facility permit and only under the operating conditions specified under paragraph (e) of this section, except in approved trial burns under the conditions specified in § 270.66 of this chapter.

(2) Hazardous wastes not specified in the permit may not be burned until operating conditions have been specified under a new permit or permit modification, as applicable. Operating requirements for new wastes may be based on either trial burn results or alternative data included with part B of a permit application under § 270.22 of this chapter.

(3) Boilers and industrial furnaces operating under the interim status standards of § 266.103 are permitted under procedures provided by § 270.66(g) of this chapter.

(4) A permit for a new boiler or industrial furnace (those boilers and industrial furnaces not operating under the interim status standards) must establish appropriate conditions for each of the applicable requirements of this section, including but not limited to allowable hazardous waste firing rates and operating conditions necessary to meet the requirements of paragraph (e) of this section, in order to comply with the following standards:

(i) For the period beginning with initial introduction of hazardous waste and ending with initiation of the trial burn, and only for the minimum time required to bring the device to a point of operational readiness to conduct a trial burn, not to exceed a duration of 720 hours operating time when burning hazardous waste, the operating requirements must be those most likely to ensure compliance with the emission standards of §§ 266.104 through 266.107, based on the Director's engineering judgment. If the applicant is seeking a waiver from a trial burn to demonstrate conformance with a particular emission standard, the operating requirements during this

initial period of operation shall include those specified by the applicable provisions of § 266.104, § 266.105, § 266.106, or § 266.107. The Director may extend the duration of this period for up to 720 additional hours when good cause for the extension is demonstrated by the applicant.

(ii) For the duration of the trial burn, the operating requirements must be sufficient to demonstrate compliance with the emissions standards of §§ 266.104 through 266.107 and must be in accordance with the approved trial burn plan;

(iii) For the period immediately following completion of the trial burn, and only for the minimum period sufficient to allow sample analysis, data computation, submission of the trial burn results by the applicant, review of the trial burn results and modification of the facility permit by the Director to reflect the trial burn results, the operating requirements must be those most likely to ensure compliance with the emission standards §§ 266.104 through 266.107 based on the Director's engineering judgment.

(D) For the remaining duration of the permit, the operating requirements must be those demonstrated in a trial burn or by alternative data specified in § 270.22 of this chapter, as sufficient to ensure compliance with the emissions standards of §§ 266.104 through 266.107.

(e) *Operating requirements*—(1) *General.* A boiler or industrial furnace burning hazardous waste must be operated in accordance with the operating requirements specified in the permit at all times where there is hazardous waste in the unit.

(2) *Requirements to ensure compliance with the organic emissions standards*—(i) *DRE standard.* Operating conditions will be specified either on a case-by-case basis for each hazardous waste burned as those demonstrated (in a trial burn or by alternative data as specified

in § 270.22) to be sufficient to comply with the destruction and removal efficiency (DRE) performance standard of § 266.104(a) or as those special operating requirements provided by § 266.104(a)(4) for the waiver of the DRE trial burn. When the DRE trial burn is not waived under § 266.104(a)4), each set of operating requirements will specify the composition of the hazardous waste (including acceptable variations in the physical and chemical properties of the hazardous waste which will not affect compliance with the DRE performance standard) to which the operating requirements apply. For each such hazardous waste, the permit will specify acceptable operating limits including, but not limited to, the following conditions as appropriate:

(A) Feed rate of hazardous waste and other fuels measured and specified as prescribed in paragraph (e)(6) of this section;

(B) Minimum and maximum device production rate when producing normal product expressed in appropriate units, measured and specified as prescribed in paragraph (e)(6) of this section;

(C) Appropriate controls of the hazardous waste firing system;

(D) Allowable variation in boiler and industrial furnace system design or operating procedures;

(E) Minimum combustion gas temperature measured at a location indicative of combustion chamber temperature, measured and specified as prescribed in paragraph (e)(6) of this section;

(F) An appropriate indicator of combustion gas velocity, measured and specified as prescribed in paragraph (e)(6) of this section, unless documentation is provided under § 270.66 of this chapter demonstrating adequate combustion gas residence time; and

(G) Such other operating requirements as are necessary to ensure that the DRE performance standard § 266.104(a) is met.

(ii) *Carbon monoxide and hydrocarbon standards.* The permit must incorporate a carbon monoxide (CO) limit and, as appropriate, a hydrocarbon (HC) limit as provided by paragraphs (b), (c), (d), (e) and (f) of § 266.104. The permit limits will be specified as follows:

(A) When complying with the CO standard of § 266.104(b)(1), the permit limit is 100 ppmv;

(B) When complying with the alternative CO standard under § 266.104(c), the permit limit for CO is based on the trial burn and is established as the average over all valid runs of the highest hourly rolling average CO level of each run, and the permit limit for HC is 20 ppmv (as defined in § 266.104(c)(1), except as provided in § 266.104(f).

(C) When complying with the alternative HC limit for industrial furnaces under § 266.104(f), the permit limit for HC and CO is the baseline level when hazardous waste is not burned as specified by that paragraph.

(iii) *Start-up and shut-down.* During start-up and shut-down of the boiler or industrial furnace, hazardous waste (except waste fed solely as an ingredient under the Tier I (or adjusted Tier I) feed rate screening limits for metals and chloride/chlorine, and except low risk waste exempt from the trial burn requirements under §§ 266.104(a)(5), 266.105, 266.106, and 266.107) must not be fed into the device unless the device is operating within the conditions of operation specified in the permit.

(3) *Requirements to ensure conformance with the particulate standard.* (i) Except as provided in paragraphs (e)(3)(ii) and (iii) of this section, the permit shall specify the following operating requirements to ensure conformance with the particulate standard specified in § 266.105;

(A) Total ash feed rate to the device from hazardous waste, other fuels, and industrial furnace feedstocks, measured and specified as prescribed in paragraph (e)(6) of this section;

(B) Maximum device production rate when producing normal product expressed in appropriate units, and measured and specified as prescribed in paragraph (e)(6) of this section;

(C) Appropriate controls on operation and maintenance of the hazardous waste firing system and any air pollution control system;

(D) Allowable variation in boiler and industrial furnace design including any air pollution control system or operating procedures; and

(E) Such other operating requirements as are necessary to ensure that the particulate standard in § 266.111 (b) is met.

(ii) Permit conditions to ensure conformance with the particulate matter standard shall not be provided for facilities exempt from the particulate matter standard under § 266.105(b);

(iii) For cement kilns and light-weight aggregate kilns, permit conditions to ensure compliance with the particulate standard shall not limit the ash content of hazardous waste or other feed materials.

(4) *Requirements to ensure conformance with the metals emissions standard.* (i) For conformance with the Tier I (or adjusted Tier I) metals feed rate screening limits of paragraphs (b) or (e) of § 266.106, the permit shall specify the following operating requirements;

(A) Total feed rate of each metal in hazardous waste, other fuels, and industrial furnace feedstocks measured and specified under provisions of paragraph (e)(6) of this section;

(B) Total feed rate of hazardous waste measured and specified as prescribed in paragraph (e)(6) of this section;

(C) sampling and metals analysis program for the hazardous waste, other fuels, and industrial furnace feedstocks;

(ii) For conformance with the Tier II metals emission rate screening limits under § 266.106(c) and the Tier III metals controls under § 266.106(d), the permit shall specify the following operating requirements:

(A) Maximum emission rate for each metal specified as the average emission rate during the trial burn;

(B) Feed rate of total hazardous waste and pumpable hazardous waste, each measured and specified as prescribed in paragraph (e)(6)(i) of this section;

(C) Feed rate of each metal in the following feedstreams, measured and specified as prescribed in paragraphs (e)(6) of this section:

(1) Total feed streams;

(2) Total hazardous waste feed; and

(3) Total pumpable hazardous waste feed;

(D) Total feed rate of chlorine and chloride in total feed streams measured and specified as prescribed in paragraph (e)(6) of this section;

(E) Maximum combustion gas temperature measured at a location indicative of combustion chamber temperature, and measured and specified as prescribed in paragraph (e)(6) of this section;

(F) Maximum flue gas temperature at the inlet to the particulate matter air pollution control system measured and specified as prescribed in paragraph (e)(6) of this section;

(G) Maximum device production rate when producing normal product expressed in appropriate units and measured and specified as prescribed in paragraph (e)(6) of this section;

(H) Appropriate controls on operation and maintenance of the hazardous waste firing system and any air pollution control system;

(I) Allowable variation in boiler and industrial furnace system design including any air pollution control system or operating procedures; and

(J) Such other operating requirements as are necessary to ensure that the metals standards under §§ 266.106 (c) or 266.106(d) are met.

(iii) For conformance with an alternative implementation approach approved by the Director under § 266.106 (f), the permit will specify the following operating requirements:

(A) Maximum emission rate for each metal specified as the average emission rate during the trial burn;

(B) Feed rate of total hazardous waste and pumpable hazardous waste, each measured and specified as prescribed in paragraph (e)(6)(i) of this section;

(C) Feed rate of each metal in the following feedstreams, measured and specified as prescribed in paragraph (e)(6) of this section:

(1) Total hazardous waste feed; and

(2) Total pumpable hazardous waste feed;

(D) Total feed rate of chlorine and chloride in total feed streams measured and specified prescribed in paragraph (e)(6) of this section;

(E) Maximum combustion gas temperature measured at a location indicative of combustion chamber temperature, and measured and specified as prescribed in paragraph (e)(6) of this section;

(F) Maximum flue gas temperature at the inlet to the particulate matter air pollution control system measured and specified as prescribed in paragraph (e)(6) of this section;

(G) Maximum device production rate when producing normal product expressed in appropriate units and measured and specified as prescribed in paragraph (e)(6) of this section;

(H) Appropriate controls on operation and maintenance of the hazardous waste firing system and any air pollution control system;

(I) Allowable variation in boiler and industrial furnace system design including any air pollution control system or operating procedures; and

(J) Such other operating requirements as are necessary to ensure that the metals standards under §§ 266.106 (c) or 266,106(d) are met.

(5) *Requirements to ensure conformance with the hydrogen chloride and chlorine gas standards.* (i) For conformance with the Tier I total chloride and chlorine feed rate screening limits of § 266.107(b)(1), the permit will specify the following operating requirements:

(A) Feed rate of total chloride and chlorine in hazardous waste, other fuels, and industrial furnace feedstocks measured and specified as prescribed in paragraph (e)(6) of this section;

(B) Feed rate of total hazardous waste measured and specified as prescribed in paragraph (e)(6) of this section;

(C) A sampling and analysis program for total chloride and chlorine for the hazardous waste, other fuels, and industrial furnace feedstocks;

(ii) For conformance with the Tier II HC1 and $Cl_2$ emission rate screening limits under § 266.107(b)(2) and

the Tier III HCl controls under § 266.107(c), the permit will specify the following operating requirements:

(A) Maximum emission rate for HCl and for $Cl_2$ specified as the average emission rate during the trial burn;

(B) Feed rate of total hazardous waste measured and specified as prescribed in paragraph (e)(6) of this section;

(C) Total feed rate of chlorine and chloride in total feed streams, measured and specified as prescribed in paragraph (e)(6) of this section;

(D) Maximum device production rate when producing normal product expressed in appropriate units, measured and specified as prescribed in paragraph (e)(6) of this section;

(E) Appropriate controls on operation and maintenance of the hazardous waste firing system and any air pollution control system;

(F) Allowable variation in boiler and industrial furnance system design including any air pollution control system or operating procedures; and

(G) Such other operating requirements as are necessary to ensure that the HC1 and $Cl_2$ standards under § 266.107(b)(2) or (c) are met.

(6) *Measuring parameters and establishing limits based on trial burn data*—(i) *General requirements.* As specified in paragraphs (e)(2) through (e)5) of this section, each operating parameter shall be measured, and permit limits on the parameter shall be established, according to either of the following procedures:

(A) *Instantaneous limits.* A parameter may be measured and recorded on an instantaneous basis (i.e., the value that occurs at any time) and the permit limit specified as the time-weighted average during all valid runs of the trial burn; or

(B) *Hourly rolling average.* (*1*) The limit for a parameter may be established and continuously monitored on an hourly rolling average basis defined as follows:

(*i*) A continuous monitor is one which continuously samples the regulated parameter without interruption, and evaluates the detector response at least once each 15 seconds, and computes and records the average value at last every 60 seconds.

(*ii*) An hourly rolling average is the arithmetic means of the 60 most recent 1-minute average values recorded by the continuous monitoring system.

(2) The permit limit for the parameter shall be established based on trial burn data as the average over all valid test runs for the highest hourly rolling average value for each run.

(ii) *Rolling average limits for carcinogenic metals and lead.* Feed rate limits for the carcinogenic metals (i.e., arsenic, beryllium, cadmium and chromium) and lead may be established either on an hourly rolling average basis as prescribed by paragraph (e)(6)(i) of this section or on (up to) a 24 hour rolling average basis. If the owner or operator elects to use an average period from 2 to 24 hours:

(A) The feed rate of each metal shall be limited at any time to ten times the feed rate that would be allowed on an hourly rolling average basis;

(B) The continuous monitor shall meet the following specifications:

(*1*) A continuous monitor is one which continuously samples the regulated parameter without interruption, and evaluates the detector response at least once each 15 seconds, and computes and records the average value at least every 60 seconds.

(2) The rolling average for the selected averaging period is defined as the arithmetic means of the most recent

one hour block average for the average period. A one hour block average is the arithmetic means of one minute averages recorded during the 60-minute period beginning at one minute after the beginning of preceding clock hour; and

(C) The permit limit for the feed rate of each metal shall be established based on trial burn data as the average over all valid test runs of the highest hourly rolling average fee rate for each run.

(iii) *Feed rate limits for metals, total chloride and chlorine, and ash.* Feed rate limits for metals, total chlorine and chloride, and ash are established and monitored by knowing the concentration of the substance (i.e., metals, chloride/chlorine, and ash) in each feedstream and the flow rate of the feedstream. To monitor the feed rate of these substances, the flow rate of each feedstream must be monitored under the continuous monitoring requirements of paragraphs (e)(6)(i) and (ii) of this section.

(iv) *Conduct of trial burn testing.* (A) If compliance with all applicable emissions standards of §§ 266.104 through 266.107 is not demonstrated simultaneously during a set of test runs, the operating conditions of additional test runs required to demonstrate compliance with remaining emissions standards must be as close as possible to the original operating conditions.

(B) Prior to obtaining test data for purposes of demonstrating compliance with the emissions standards of §§ 266.104 through 266.107 or establishing limits on operating parameters under this section, the facility must operate under trial burn conditions for a sufficient period to reach steady-state operations. The Director may determine, however, that industrial furnaces that recycle collected particulate matter back into the furnace and that comply with an alternative implementation approach for metals under § 266.106(f), need not reach steady state

conditions with respect to the flow of metals in the system prior to beginning compliance testing for metals emissions.

(C) Trial burn data on the level of an operating parameter for which a limit must be established in the permit must be obtained during emissions sampling for the pollutant(s) (i.e., metals, PM, HCl/$Cl_2$, organic compounds) for which the parameter must be established as specified by paragraph (e) of this section.

(7) *General requirements*—(i) *Fugitive emissions.* Fugitive emissions must be controlled by:

(A) Keeping the combustion zone totally sealed against fugitive emissions; or

(B) Maintaining the combustion zone pressure lower than atmospheric pressure; or

(C) An alternate means of control demonstrated (with part B of the permit application) to provide fugitive emissions control equivalent to maintenance of combustion zone pressure lower than atmospheric pressure.

(ii) *Automatic waste feed cutoff.* A boiler or industrial furnace must be operated with a functioning system that automatically cuts off the hazardous waste feed when operating conditions deviate from those established under this section. The Director may limit the number of cutoffs per an operating period on a case-by-case basis. In addition:

(A) The permit limit for (the indicator of) minimum combustion chamber temperature must be maintained while hazardous waste or hazardous waste residues remain in the combustion chamber.

(B) Exhaust gases must be ducted to the air pollution control system operated in accordance with the permit requirements while hazardous waste or hazardous waste residues remain in the combustion chamber; and

(C) Operating parameters for which permit limits are established must continue to be monitored during the cutoff, and the hazardous waste feed shall not be restarted until the levels of those parameters comply with the permit limits. For parameters that may be monitored on an instantaneous basis, the Director will establish a minimum period of time after a waste feed cutoff during which the parameter must not exceed the permit limit before the hazardous waste feed may be restarted.

(iii) *Changes.* A boiler or industrial furnace must cease burning hazardous waste when changes in combustion properties, or feed rates of the hazardous waste, other fuels, or industrial furnace feedstock, or changes in the boiler or industrial furnace design or operating conditions deviate from the limits as specified in the permit.

(8) *Monitoring and Inspections.* (1) The owner or operator must monitor and record the following, at a minimum, while burning hazardous waste:

(A) If specified by the permit, feed rates and composition of hazardous waste, other fuels, and industrial furnace feedstocks, and feed rates of ash, metals, and total chloride and chlorine;

(B) If specified by the permit, carbon monoxide (CO), hydrocarbons (HC), and oxygen on a continuous basis at a common point in the boiler or industrial furnace downstream of the combustion zone and prior to release of stack gases to the atmosphere in accordance with operating requirements specified in paragraph (e)(2)(ii) of this section. CO, HC, and oxygen monitors must be installed, operated, and maintained in accordance with methods specified in appendix IX of this part.

(C) Upon the request of the Director, sampling and analysis of the hazardous waste (and other fuels and industrial furnace feedstocks as appropriate), residues, and exhaust emissions must be conducted to verify that the operating requirements established in the permit achieve

the applicable standards of §§ 266.104, 266.105, 266.106, and 266.107.

(ii) All monitors shall record data in units corresponding to the permit limit unless otherwise specific in the permit.

(iii) The boiler or industrial furnace and associated equipment (pumps, values, pipes, fuel storage tanks, etc.) must be subjected to thorough visual inspection when it contains hazardous waste, at least daily for leaks, spills, fugitive emissions, and signs of tampering.

(iv) The automatic hazardous waste feed cutoff system and associated alarms must be tested at least once every 7 days when hazardous waste is burned to verify operability, unless the applicant demonstrates to the Director that weekly inspections will unduly restrict or upset operations and that less frequent inspections will be adequate. At a minimum, operational testing must be conducted at least once every 30 days.

(v) These monitoring and inspection data must be recorded and the records must be placed in the operating record required by § 264.73 of this chapter.

(9) *Direct transfer to the burner.* If hazardous waste is directly transferred from a transport vehicle to a boiler or industrial furnace without the use of a storage unit, the owner and operator must comply with § 266.111.

(10) *Recordkeeping.* The owner or operator must keep in the operating record of the facility all information and data required by this section for not less than three years.

(11) *Closure.* At closure, the owner or operator must remove all hazardous waste and hazardous waste residues (including, but not limited to, ash, scrubber waters, and scrubber sludges) from the boiler or industrial furnace.

(Approved by the Office of Management and Budget under control number 2050-0073)

§ 266.104 Standards to control organic emissions.

(a) *DRE standard*—(1) *General.* Except as provided in paragraph (a)(3) of this section, a boiler or industrial furnace burning hazardous waste must achieve a destruction and removal efficiency (DRE) of 99.99% for all organic hazardous constituents in the waste feed. To demonstrate conformance with this requirement, 99.99% DRE must be demonstrated during a trial burn for each principal organic hazardous constituent (POHC) designated (under paragraph (a)(2) of this section) in its permit for each waste feed. DRE is determined for each POHC from the following equation:

$$DRE = \left( \frac{1 - W_{out}}{W_{in}} \right) \times 100$$

where:

$W_{in}$=Mass feed rate of one principal organic hazardous constituent (POHC) in the hazardous waste fired to the boiler or industrial furnace; and

$W_{out}$=Mass emission rate of the same POHC present in stack gas prior to release to the atmosphere.

(2) *Designation of POHCs.* Principal organic hazardous constituents (POHCs) are those compounds for which compliance with the DRE requirements of this section shall be demonstrated in a trial burn in conformance with procedures prescribed in § 270.66 of this chapter. One or more POHCs shall be designated by the Director for each waste feed to be burned. POHCs shall be designated based on the degree of difficulty of destruction of the organic constituents in the waste and on their concentrations or mass in the waste feed considering the results of waste analyses submitted with part B of the permit application. POHCs are most likely to be selected from among those compounds listed in part 261, appendix VIII of this chapter that are also present in the normal waste feed. However, if the applicant demonstrates

to the Regional Administrator's satisfaction that a compound not listed in appendix VIII or not present in the normal waste feed is a suitable indicator of compliance with the DRE requirements of this section, that compound may be designated as a POHC. Such POHCs need not be toxic or organic compounds.

(3) *Dioxin-listed waste.* A boiler or industrial furnace burning hazardous waste containing (or derived from) EPA Hazardous Wastes Nos. F020, F021, F022, F023, F026, or F027 must achieve a destruction and removal efficiency (DRE) of 99.9999% for each POHC designated (under paragraph (a)(2) of this section), in its permit. This performance must be demonstrated on POHCs that are more difficult to burn than tetrra,- penta-, and hexachlorodibenzo-*p*-dioxins and dibenzofurans. DRE is determined for each POHC from the equation in paragraph (a) of this section. In addition, the owner or operator of the boiler or industrial furnace must notify the Director of intent to burn EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, or F027.

(4) *Automatic waiver of DRE trial burn.* Owners and operators of boilers operated under the special operating requirements provided by § 266.110 are considered to be in compliance with the DRE standard of paragraph (a)(1) of this section and are exempt from the DRE trial burn.

(5) *Low risk waste.* Owners and operators of boilers or industrial furnaces that burn hazardous waste in compliance with the requirements of § 266.109(a) are considered to be in compliance with the DRE standard of paragraph (a)(1) of this section and are exempt from the DRE trial burn.

(b) *Carbon monoxide standard.* (1) Except as provided in paragraph (c) of this section, the stack gas concentration of carbon monoxide (CO) from a boiler or industrial furnace burning hazardous waste cannot exceed 100 ppmv on an hourly rolling average basis (i.e., over

60 minute period), continuously corrected to 7 percent oxygen, dry gas basis.

(2) CO and oxygen shall be continuously monitored in conformance with "Performance Specifications for Continuous Emission Monitoring of Carbon Monoxide and Oxygen in Hazardous Waste Incinerators, Boilers, and Industrial Furnaces" in appendix IX of this part.

(3) Compliance with the 100 ppmv CO limit must be demonstrated during the trial burn (for new facilities or an interim status facility applying for a permit) or the compliance test (for interim status facilities). To demonstrate compliance, the highest hourly rolling average CO level during any valid run of the trial burn or compliance test must not exceed 100 ppmv.

(c) *Alternative carbon monoxide standard.* (1) The stack gas concentration of carbon monoxide (CO) from a boiler or industrial furnace burning hazardous waste may exceed the 100 ppmv limit provided that stack gas concentrations of hydrocarbons (HC) do not exceed 20 ppmv, except as provided by paragraph (f) of this section for certain industrial furnaces.

(2) HC limits must be established under this section on an hourly rolling average basis (i.e., over any 60 minute period), reported as propane, and continuously corrected to 7 percent oxygen, dry gas basis.

(3) HC shall be continuously monitored in conformance with "Performance Specifications for Continuous Emission Monitoring of Hydrocarbons for Incinerators, Boilers, and Industrial Furnaces" in appendix IX of this part. CO oxygen shall be continuously monitored in conformance with paragraph (b)(2) of this section.

(4) The alternative CO standard is established based on CO data during the trial burn (for a new facility) and the compliance test (for an interim status facility). The alternative CO standard is the average over all valid runs of the highest hourly average CO level for each run.

The CO limit is implemented on an hourly rolling average basis, and continuously corrected to 7 percent oxygen, dry gas basis.

(d) *Special requirements for furnaces.* Owners and operators of industrial furnaces (e.g., kilns, cupolas) that feed hazardous waste for a purpose other than solely as an ingredient (see § 266.103(a)(5)(ii)) at any location other than the end where products are normally discharged and where fuels are normally fired must comply with the hydrocarbon limits provided by paragraphs (c) or (f) of this section irrespective of whether stack gas CO concentrations meet the 100 ppmv limit of paragraph (b) of this section.

(e) *Controls for dioxins and furans.* Owners and operators of boilers and industrial furnaces that are equipped with a dry particulate matter control device that operates within the temperature range of 450-750 °F, and industrial furnaces operating under an alternative hydrocarbon limit established under paragraph (f) of this section must conduct a site-specific risk assessment as follows to demonstrate that emissions of chlorinated dibenzo-*p*-dioxins and dibenzofurans do not result in an increased lifetime cancer risk to the hypothetical maximum exposed individual (MEI) exceeding 1 in 100,000;

(1) During the trial burn (for new facilities or an interim status facility applying for a permit) or compliance test (for interim status facilities), determine emission rates of the tetra-octa congeners of chlorinated dibenzo-*p*-dioxins and dibenzofurans (CDDs/CDFs) using Method 23, "Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDFs) from Stationary Sources", in appendix IX of this part.

(2) Estimate the 2,3,7,8-TCDD toxicity equivalence of the tetra-octa CDDs/CDFs congeners using "Procedures for Estimating the Toxicity Equivalence of Chlorinated Dibenzo-p-Dioxin and Dibenzofuran Congeners" in ap-

pendix IX of this part. Multiply the emission rates of CDD/CDF congeners with a toxicity equivalence greater than zero (see the procedure) by the calculated toxicity equivalence factor to estimate the equivalent emission rate of 2,3,7,8-TCDD.

(3) Conduct dispersion modeling using methods recommended in *Guideline on Air Quality Models (Revised)* or the Hazardous Waste Combustion Air Quality Screening Procedure", which are provided in appendices X and IX, respectively, of this part, or "EPA SCREEN Screening Procedure" as described in *Screening Procedures for Estimating Air Quality Impact of Stationary Sources* (incorporated by reference in § 260.11) to predict the maximum annual average off-site ground level concentration of 2,3,7,8-TCDD equivalents determined under paragraph (e)(2) of this section. The maximum annual average on-site concentration must be used when a person resides on-site; and

(4) The ratio of the predicted maximum annual average ground level concentration of 2,3,7,8-TCDD equivalents to the risk-specific dose for 2,3,7,8-TCDD provided in appendix V of this part $2.2 \times 10^{-7}$) shall not exceed 1.0.

(f) *Alternative HC limit for furnaces with organic matter in raw material.* For industrial furnaces that cannot meet the 20 ppmv HC limit because of organic matter in normal raw material, the Director may establish an alternative HC limit on a case-by-case basis (under a part B permit proceeding) at a level that ensures that flue gas HC (and CO) concentrations when burning hazardous waste are not greater than when not burning hazardous waste (the baseline HC level) provided that the owner or operator complies with the following requirements. However, cement kilns equipped with a by-pass duct meeting the requirements of paragraph (g) of this section, are not eligible for an alternative HC limit.

(1) The owner or operator must demonstrate that the facility is designed and operated to minimize hydrocarbon emissions from fuels and raw materials when the baseline HC (and CO) level is determined. The baseline HC (and CO) level is defined as the average over all valid test runs of the highest hourly rolling average value for each run when the facility does not burn hazardous waste, and produces normal products under normal operating conditions feeding normal feedstocks and fuels. More than one baseline level may be determined if the facility operates under different modes that may generate significantly different HC (and CO) levels;

(2) The owner or operator must develop an approach to monitor over time changes in the operation of the facility that could reduce the baseline HC level;

(3) The owner or operator must conduct emissions testing during the trial burn to:

(i) Determine the baseline HC (and CO) level;

(ii) Demonstrate that, when hazardous waste is burned, HC (and CO) levels do not exceed the baseline level; and

(iii) Identify the types and concentrations of organic compounds listed in appendix VIII, part 261 of this chapter, that are emitted and conducts dispersion modeling to predict the maximum annual average ground level concentration of each organic compound. On-site ground level concentrations must be considered for this evaluation if a person resides on site.

(A) Sampling and analysis of organic emissions shall be conducted using procedures prescribed by the Director.

(B) Dispersion modeling shall be conducted according to procedures provided by paragraph (e)(2) of this section; and

(iv) Demonstrate that maximum annual average ground level concentrations of the organic compounds

identified in paragraph (f)(3)(iii) of this section do not exceed the following levels:

(A) For the noncarcinogenic compounds listed in appendix IV of this part, the levels established in appendix IV;

(B) For the carcinogenic compounds listed in appendix V of this part, the sum for all compounds of the ratios of the actual ground level concentration to the level established in appendix V cannot exceed 1.0. To estimate the health risk from chlorinated dibenzo-p-dioxins and dibenzofuran congeners, use the procedures prescribed by paragraph (e)(3) of this section to estimate the 2,3,7,8-TCDD toxicity equivalence of the congeners.

(C) For compounds not listed in appendix IV or V, 0.1 micrograms per cubic meter.

(4) All hydrocarbon levels specified under this paragraph are to be monitored and reported as specified in paragraphs (c)(1) and (c)(2) of this section.

(g) *Monitoring CO and HC in the bypass duct of a cement kiln.* Cement kilns may comply with the carbon monoxide and hydrocarbon limits provided by paragraphs (b), (c), and (d) of this section by monitoring in the by-pass duct provided that:

(1) Hazardous waste is fired only into the kiln and not at any location downstream from the kiln exit relative to the direction of gas flow; and

2. The by-pass duct diverts a minimum of 10% of kiln off-gas into the duct.

(h) *Use of emissions test data to demonstrate compliance and establish operating limits.* Compliance with the requirements of this section must be demonstrated simultaneously by emissions testing or during separate runs under identical operating conditions. Further, data to demonstrate compliance with the CO and HC limits of this section or to establish alternative CO or HC limits

under this section must be obtained during the time that DRE testing, and where applicable, CDD/CDF testing under paragraph (e) of this section and comprehensive organic emissions testing under paragraph (f) is conducted.

(i) *Enforcement.* For the purposes of permit enforcement, compliance with the operating requirements specified in the permit (under § 266.102) will be regarded as compliance with this section. However, evidence that compliance with those permit conditions is insufficient to ensure compliance with the requirements of this section may be "information" justifying modification or revocation and re-issuance of a permit under § 270.41 of this chapter.

§ 266.105 Standards to control particulate matter.

(a) A boiler or industrial furnace burning hazardous waste may not emit particulate matter in excess of 180 milligrams per dry standard cubic meter (0.08 grains per dry standard cubic foot) after correction to a stack gas concentration of 7% oxygen, using procedures prescribed in 40 CFR part 60, appendix A, methods 1 through 5, and appendix IX of this part.

(b) An owner or operator meeting the requirements of § 266.109(b) for the low risk waste exemption is exempt from the particulate matter standard.

(c) For the purposes of permit enforcement, compliance with the operating requirements specified in the permit (under § 266.102) will be regarded as compliance with this section. However, evidence that compliance with those permit conditions is insufficient to ensure compliance with the requirements of this section may be "information" justifying modification or revocation and reissuance of a permit under § 270.41 of this chapter.

## APPENDIX I

**Excerpt from Joint Brief of Industry Petitioners and Intervenors in Support, Filed in *Horsehead Resource Development Co. v. Browner*, Nos. 91-1221 *et al.***

B. In the Absence of a Viable Alternative Means for Demonstrating "Good Combustion," EPA's Tier I and Tier II Controls Are Arbitrary and Capricious Because Petitioners' Cement Kilns' Failure to Comply With the Tier I Carbon Monoxide Limit and the Tier II Hydrocarbon Limit Does Not Indicate a Lack of Good Combustion.

In imposing a 100 ppmv CO stack gas limit or, if necessary, a 20 ppmv HC stack gas limit on cement kilns such as Petitioners', the EPA has failed utterly to rationally connect the facts it found and the choice it made. In *National Treasury Employees Union v. Horner*, 854 F.2d at 498, this Court found it useful to set forth the "chain of reasoning" followed by the agency. EPA's reasoning for imposing CO stack gas emission limits proceeded as follows:

1) The first stage of the combustion process of POHCs can result in the creation and emission of PICs;

2) The first stage of the combustion process also produces CO;

3) PICs are destroyed before CO is oxidized to $CO_2$ in a second stage of combustion;

4) Low levels of CO in flue gas therefore indicate that the combustion process has proceeded past the point at which PICs would be destroyed; and therefore,

5) Limiting CO levels in flue gas to levels indicative of high combustion efficiency will limit the risk that the combustion process in question is emitting PICs.

*Cf.* 56 Fed. Reg. at 7150, J.A. 400.

This line of reasoning led EPA to rule that "the stack gas concentration of carbon monoxide (CO) from a boiler or industrial furnace burning hazardous waste cannot exceed 100 ppmv . . . ." 40 C.F.R. § 266.104(b)(1). However, this reasoning fails when applied to cement kilns: CO and HC levels in a cement kiln's *stack gas* are not necessarily indicative of the level of CO or HC produced by the cement Kiln's combustion of hazardous waste fuel.

EPA's use of a 20 ppmv HC emission limit for wet process cement kilns was also fundamentally irrational. The 20 ppmv HC emission limit was a technology-based limit derived from respondent's study of incinerator and boiler technology. However, in the case of certain cement kilns and certain boilers, EPA admits that THC emissions in excess of 20 ppmv indicate neither CO levels exceeding 100 ppmv nor poor combustion conditions. 54 Fed. Reg. at 43724, J.A. 962; *Emissions Testing of a Wet Process Cement Kiln at Hannibal, Missouri,* Docket No. BBSP-S0147 at 2-2, 4-30, J.A. 196, 226 (concluding that "the carbon input [from organic matter in raw materials] was sufficient to account for the HC output from the stack"). EPA has not explained why it nonetheless purports to apply the 20 ppmv HC limit as a measure of "good combustion" in cement kilns. *See National Coalition Against the Misuse of Pesticides v. Thomas,* 809 F.2d 875, 883-84 (D.C. Cir. 1987) (EPA's failure to explain its reversal of position on health risks of EDB residue rendered its tolerance rule arbitrary and capricious); *Speciality Equipment Market Ass'n v. Ruckelshaus,* 720 F.2d 124, 136-37 (D.C. Cir. 1983) (EPA's rules arbitrarily and capriciously precluded short tests as a certification basis when short tests would have accomplished the purpose said to underlie certification testing).

EPA is well aware that where cement kilns such as Petitioners' are concerned, stack measurements of CO and HC levels are not reliable indicators of levels of CO and HC created as a result of the hazardous waste combus-

tion process.[58] "Normal raw materials such as limestone can contain traces of organic materials that oxidize incompletely as the raw material moves down the kiln from the feed end to the hot end where fuels are normally fired. Clearly, *any HC (or CO) resulting from this phenomenon has nothing to do with combustion of hazardous waste fuel.*" 55 Fed. Reg. at 17885, J.A. 1073 (emphasis added); *accord*, 54 Fed. Reg. at 43724, J.A. 962; *see also* 52 Fed. Reg. at 16999, J.A. 884; *Report of the Products of Incomplete Combustion Subcommittee of the Science Advisory Board*, Docket No. BBSP-S0124 at 22282, J.A. 151 ("The correlation of CO, THC, or other parameters with combustion efficiency is weak for some conditions and for some combustion devices").

On such facts, this Circuit clearly holds that selecting one possible interpretation from a set of ambiguous test results is arbitrary and capricious. In *Kent County, Delaware Levy Court v. United States Environmental Protection Agency*, 963 F.2d 391, 397-98 (D.C. Cir. 1992), EPA justified its decision to list a site on the National Priority List by noting that a water sample taken from a monitoring well had higher levels of arsenic than a sample from a background well. This Court held the decision to be arbitrary and capricious because EPA had failed to refute the possibility that the higher arsenic level resulted from turbid water in the monitoring well (*i.e.*, water with soil particles that contain naturally-occurring arsenic).

[58] The arbitrariness of EPA's approach to determining "good combustion" in the context of cement kilns became manifest when it approved by-pass monitoring. EPA acknowledged that "[t]he by-pass duct draws the kiln off-gas prior to the precalciner or preheater and so, would not be affected by this process." 56 Fed. Reg. at 7159, J.A. 409. The EPA, after acknowledging that by-pass kiln gases would not be contaminated by gases generated by the combustion of feedstock materials, admitted that "the gases in the bypass duct are representative of the combustion of waste in the kiln." *Id.* This can only lead one to the conclusion that gases at the stack are no longer representative of "the combustion of waste in the kiln."

*Kent County* obviously applies here. In imposing a stack gas measurement of CO levels to determine "good combustion," EPA has not only failed to refute the possibility that CO and HC levels at cement kiln stacks would be increased because of CO and HC from other sources, it actively admits it.

Moreover, EPA was not entitled to speculate that failure of cement kiln stack emissions to meet the CO and HC limits indicated a failure of the hazardous waste fuel combustion process to produce CO and HC emissions in excess of the limits purported to be indicative of "good combustion." *National Gypsum Co. v. United States Environmental Protection Agency,* 968 F.2d 40, 42-45 (D.C. Cir. 1992) (holding EPA's regulation arbitrary and capricious because EPA's belief that it was "unlikely" that the boron oxide actually found on the site was the boron compound identified in groundwater did not entitle the agency to "infer" that a more hazardous boron compound was present or that boron oxide was breaking down into more hazardous boron compounds); *Natural Resources Defense Council v. United States Environmental Protection Agency,* 859 F.2d 156, 209-10 (D.C. Cir. 1988) (EPA suggested the possibility of allowing a "process upset" defense, but acted arbitrarily and capriciously by failing to adequately address its own suggestion; agency action cannot be justified by speculations).

## CONCLUSION

For the reasons set forth above, the EPA's PIC emission control regulations should be vacated.

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